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Physical Environments and the Physical Activity of Youth

by

Allan Jay Fein

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE.

Centre for Health Promotion Studies

Edmonton, Alberta

Fall 2000

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Allan Fein

September 22, 2000.

51 Bernick Road
Willowdale, Ontario
Canada
M2H 1E3

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled PHYSICAL ENVIRONMENTS AND THE PHYSICAL ACTIVITY OF YOUTH submitted by ALLAN JAY FEIN in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE.

R Plotnikoff

Ron Plotnikoff, Ph.D.

Cam Wild

Cam Wild, Ph.D.

John Spence

John Spence, Ph.D.

September 22, 2000

ABSTRACT

The overall purpose of this thesis was to examine the relationships between physical environments and physical activity in youth. Two studies were completed to accomplish the purpose. The first study examined the differences between an objective assessment and a perceived measure of the school physical environments related to physical activity. The second study examined the relationship between the perceived physical environment, the perceived importance of the physical environment and physical activity within four environmental contexts (i.e., home, neighbourhood, school and convenient facilities). From the first study, small differences were found between the objective and perceived assessments. The second study revealed moderate relationships between the perceived physical environment and physical activity, as well as between the perceived importance of the school environment with physical activity. Implications of these findings are presented with recommendations for research, practice and policy.

DEDICATION

This thesis is dedicated to the memory of my father, Ronald M. Fein who always inspired me to be physically active. His insistence to experience new and exciting people, places and things helped to develop an ever-present curiosity inside of me. Thus, for him, and for me, I will always search for answers to new questions.

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CHAPTER 1 – INTRODUCTION

1.1. Introduction

Since the beginning of the 20th century scientists have been examining the relationship between physical activity and health. Some of the benefits associated with physical activity include the reduction of risk for cardiovascular disease, certain types of cancer, diabetes and osteoporosis, along with an increase in the ability to handle many life distresses (Blair, Brill, & Barlow, 1994; Greenberg, 1996). Studies have also demonstrated that positive physical activity experiences in childhood can improve intrapersonal and interpersonal factors such as self-concept and self-esteem, social acceptance, and even romantic appeal (Malina, 1994; Calfas & Taylor, 1994; Allison & Adlaf, 1997). With these important relationships in mind, it is clear that adoption and adherence to regular physical activity is a crucial step in reducing disease and positively affecting health. If we define health as a resource for living (World Health Organization, 1986) then physical activity is a tool that we can use to positively tap this resource. However, recent studies show that only 33% of Canadian adolescents are considered active enough for optimal health benefits (Canadian Fitness & Lifestyle Research Institute, 1998). Further, this percentage is reduced to only 25% for girls when examining the sexes separately (Canadian Fitness & Lifestyle Research Institute, 1998). Since physical activity is so important to health and well-being, there is a great need to examine how to promote increased participation in youth.

Many theories have been put forth to describe physical activity behaviour. For example social-cognitive theories, such as the Theory of Planned Behaviour (Godin & Kok, 1996) and the Transtheoretical Model (Prochaska & Marcus, 1994) have been utilised to explain and predict physical activity behaviour, but they have demonstrated

limited results (Sallis & Owen, 1997). Ecological approaches (McLeroy, Bibeau, Steckler & Glanz, 1988; Richard, Potvin, Kishchuk, Prlic & Green, 1996) though more complex, appear to be very helpful in conceptualizing the multiple factors influencing physical activity behaviour (Sallis & Owen, 1997).

This thesis has two aims. The first aim (*Figure 1.1*) examines differences between observer-rated and student-perceived school environments related to physical activity. The second aim (*Figure 1.2*) is based on theoretical constructs and principles drawn from Ecological Frameworks, including the social-cognitive models of the Health Belief Model and Social Learning Theory. This aim investigates the relationship between the perceived physical environment, the perceived importance of the physical environment and physical activity in four contexts (the home physical environment, neighbourhood physical environment, convenient facilities, and school physical environment).

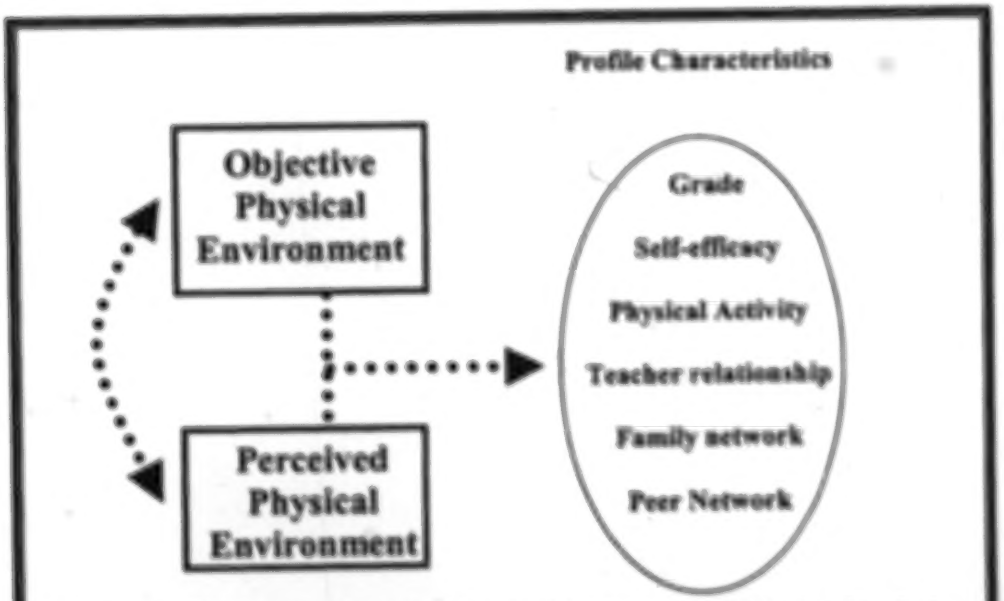

Figure 1.1 –Objective and Perceived Physical Environments Related to Physical Activity Schema: Study Aim 1

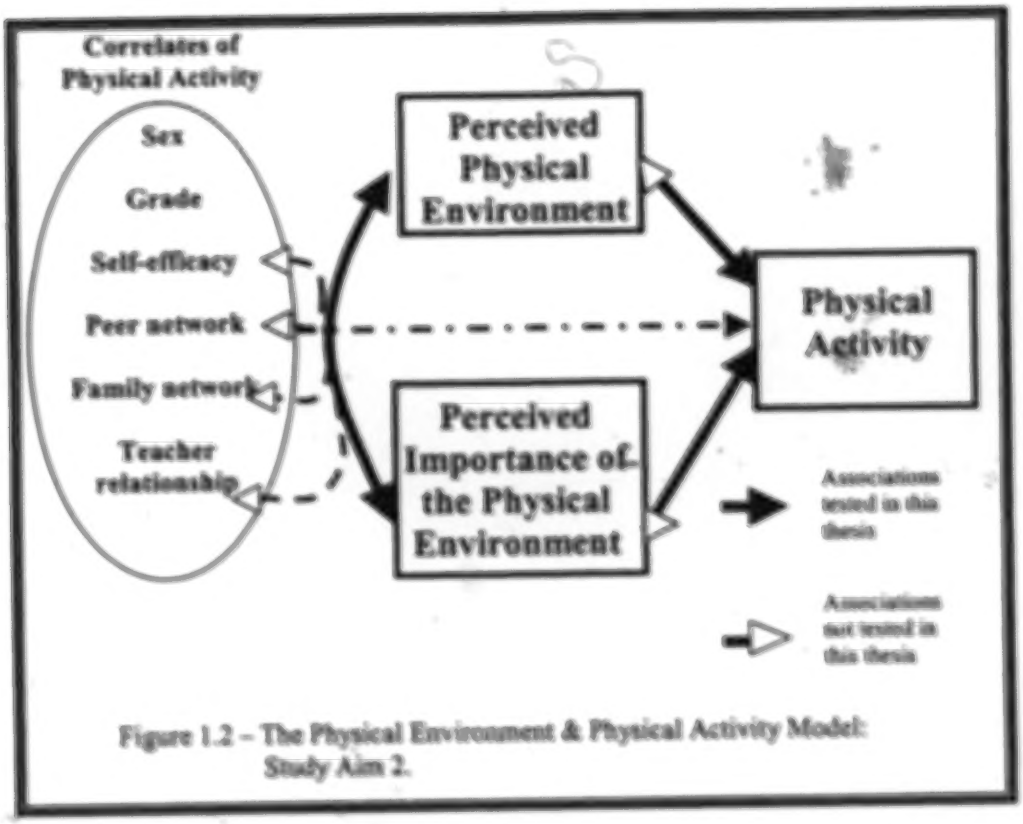

Figure 1.2 – The Physical Environment & Physical Activity Model: Study Aim 2.

The framework for Aim 1 (*Figure 1.1*) is in response to a call in the literature (i.e., Epstein, 1988) to examine the relationship between perceived and objective measures of physical environments in relation to physical activity. Differences between these two measures will be determined and profiles based on biological, psychological, social and behavioural characteristics (i.e., age, self-efficacy, peer network, family network, teacher relationship and physical activity) of individuals who perceive the physical environment as either similar to or different from the objective assessment will be examined. While these profile characteristics have not been identified in the literature to be directly related to the physical environment, their relationship with physical activity is well-known (Sallis, Prochaska & Taylor, 2000; Sallis, Simons-Morton, Stone et al.,

1992, Taylor & Sallis, 1997). Differences by sex (i.e., male and female) will also be examined.

The framework for Aim 2 (*Figure 2*) is called the Physical Environment & Physical Activity Model (PEPA Model). The key components of the PEPA Model are the *Perceived Physical Environment*, the *Perceived Importance of the Environment*, and *Physical Activity*. The rationale for including these environment constructs and the correlates with physical activity (i.e., sex, age, self-efficacy, family network, peer network and teacher relationship) will now be outlined.

An underlying assumption of all ecological models is that there is a dynamic interplay between an individual and the environment in order to produce behaviour (Catton, 1994). In the PEPA Model the arrows relating the environment constructs and physical activity represent this assumption.

Within an ecological approach, social cognitive theories targeted at the interpersonal level can help elucidate the relationship between the PEPA Model's components. Two such theories are the Health Belief Model (HBM; Rosenstock, 1990) and Social Learning Theory (Baranowski, Perry & Parcel, 1997). The key constructs from the HBM that pertain to the development of the PEPA Model are *perceived barriers* and *cues to action*. In our case, the physical environment will be idealised as a barrier. Specifically, the lack of appropriate and adequate equipment and space will prevent an individual from participating in physical activity. Conversely, appropriate physical environments can facilitate physical activity. The perceived importance of the physical environment and the actual physical environment combine to create cues to action. If an individual perceives an environment as important and has access to that environment, he

or she will be more likely to act. For example, if a student perceives a basketball court as important and the school has six courts, that student will more likely participate in basketball.

Further theoretical support for the relationship between environment and behaviour is found in Social Cognitive Theory. Specifically the principle of *reciprocal determinism* has implications for our model. Reciprocal determinism is defined very similarly to the PEPA Model in that there exists a "dynamic interaction between the person, the behaviour, and the environment in which the behaviour is performed" (Baranowski et al., 1997). As with Social Cognitive Theory, the concept of reciprocal determinism is considered as a basic assumption in the PEPA Model. However, it must be noted that this study is cross-sectional which means that the dynamic interactions (i.e., bidirectional effects) cannot be directly tested.

The physical activity correlates in the PEPA Model can be categorized as psychological (*self-efficacy*), socio-cultural (*peer support*, *family support* and *physical education teacher relationship*) and biological (*age and sex*) in nature. These are factored into the model because they have been shown to influence physical activity behaviour within adolescent populations (Mota & Queiros, 1996; Sallis et al., 1992; Wold & Anderssen, 1992; Gottlieb & Baker, 1986; Allison & Dwyer, 1999; Sallis et al., 2000; Taylor & Sallis, 1997).

1.2. Overall Rationale for the study

This study examines the relationships between the *objective physical environment related to physical activity*, the *perceived physical environment related to physical*

activity, the *perceived importance of the physical environment related to physical activity* and *physical activity* in high school-aged youth. Other correlates of physical activity (i.e., sex, age, self-efficacy, teacher, family and peer networks) are factored into the examination of these relationships.

This study is significant because it expands the knowledge base with respect to the above relationships. Furthermore, it reflects calls in the literature (Sallis et al., 2000; Sallis et al., 1992; Sallis & Owen, 1997) to develop environment measurement tools and to study the relationship between objective and perceived physical environment measures related to physical activity. Finally, the health implications surrounding physical activity (i.e., links to cardiovascular diseases, obesity and diabetes) demonstrate the necessity of completing physical activity research despite the methodological challenges and expense of such research.

1.3. Research Aim 1

The first aim of this study is to determine the relationship between objective (i.e., researcher measured) and perceived measures (i.e., self-reported questionnaires answered by subjects) of the physical environment related to physical activity. Two research questions will be answered by this aim:

Research Question 1: Do high school students accurately perceive their objective school physical environments that can promote physical activity?

Research Question 2: What factors (i.e., age, self-efficacy, teacher, family & peer network) differentiate between students who accurately and inaccurately perceive objective school environments that can promote physical activity?

Research Question 2a: What are the possible sex differences with respect to how students perceive their school physical environments?

1.4. Research Aim 2

The second aim of this study is to examine the relationships between *physical activity*, the *perceived physical environment* and the *perceived importance of the physical environment*, among four different settings (home, neighbourhood, convenient facilities and school). The following research questions will be answered:

Research Question 1: What is the relationship between the physical environment and physical activity behaviour?

Research Question 2: What is the relationship between the perceived importance of the physical environment and physical activity behaviour?

Research Question 3: What is the relationship between the physical environment and the perceived importance of the physical environment?

Research Question 4: What is the relationship between the physical environment, the perceived importance of the physical environment and physical activity when adjusted for correlates of physical activity?

1.5. Plan of the Thesis

This thesis is a *mixed format*, as classified by the guidelines set by the Faculty of Graduate Studies and Research and the Centre for Health Promotion Studies at the University of Alberta. Following this introduction, Chapters Two and Three respectively address Aim 1 and Aim 2 as two independent manuscripts. Each of these papers includes its own specific introduction, methods, results and discussion sections. It is to be noted that repetition within each paper (i.e., portions of the methods sections) is to be expected. Following the two papers will be a brief synthesising and concluding chapter and the appendices. A detailed literature review pertinent to this thesis along with methodological details not discussed in the individual papers will be presented as appended chapters.

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CHAPTER 2 – PAPER #1

An examination of adolescents' perceptions of the school physical environment related to physical activity

A.J. Fein[1], R.C. Plotnikoff[2], T.C. Wild[3], J.C. Spence[4]

[1]Centre for Health Promotion Studies, University of Alberta, Canada
[2]Centre for Health Promotion Studies, Alberta Centre for Well-Being, Faculty of Physical Education, University of Alberta, Canada
[3]Centre for Health Promotion Studies, University of Alberta, Canada
[4]Alberta Centre for Well-Being, Canada

ABSTRACT

The aim of this study was to examine the relationship between an objective and perceived measure of the physical environment related to physical activity within a school setting. A self-report questionnaire to assess the perceived physical environment was completed by 850 male and female students in four high schools in rural Alberta, Canada. Two researchers completed objective observations in the same four schools. The students were grouped as perceiving the school environment (1) accurately, (2) affording greater opportunities, or (3) providing fewer opportunities. Discriminant analysis revealed two significant functions which differentiated between the three groups based on variables associated with physical activity in youth (i.e., age, self-efficacy, peer network, family network, and teacher relationship) and on activity level. The first discriminant function's canonical correlations showed that teacher relationship (.91) and activity level (.42) were most predictive of individuals who perceived more opportunities than the assessed in the objective measure. The second function's canonical correlations found that peer network (.63), self-efficacy (.41) and activity level (-.37) were the best at predicting individuals who perceived inaccurately. When examined by sex the discriminant analysis revealed only one significant function. For both females and males, this function's strongest predictors included teacher relationship and energy expenditure, while for males only self-efficacy and family network were also highly correlated. The discriminant analysis's model equation correctly classified 68.0% of the cases, 16.6% more cases than would be predicted by chance alone. Overall, the small mean difference score (0.37) between the three groups directs researchers to use either objective or perceived measures of the physical environment, as both should provide similar results.

INTRODUCTION

Physical activity is important to health and well-being (Blair, Brill, & Barlow, 1994; Greenberg, 1996; Malina, 1994; Calfas & Taylor, 1994; Allison & Adlaf, 1997). However, recent studies show that only 33% of Canadian adolescents are considered active enough for optimal health benefits (Canadian Fitness & Lifestyle Research Institute, 1998). Further, this percentage is reduced to only 25% for girls when examining the sexes separately (Canadian Fitness & Lifestyle Research Institute, 1998). Therefore, studies on how to promote increased participation in youth must be conducted.

Research approaches aimed at increasing physical activity levels are varied. For example social-cognitive theories, such as the Theory of Planned Behaviour (Godin & Kok, 1996) and the Transtheoretical Model (Prochaska & Marcus, 1994) have been employed to explain and predict physical activity behaviour but they have demonstrated limited results (Sallis & Owen, 1997). Recent ecological approaches (McLeroy, Bibeau, Steckler & Glanz, 1988; Richard, Potvin, Kishchuk, Prlic & Green, 1996) have potential in further accounting for the many environmental factors influencing physical activity behaviour (Sallis & Owen, 1997).

A large number of factors have been studied as predictors of physical activity. Current reviews (Sallis, Prochaska & Taylor 2000; Taylor & Sallis, 1997) demonstrate a relationship between 48 biological, psychological, behavioural and sociocultural factors and physical activity in adolescents. However, very few studies have examined the role of the physical environment on physical activity (Sallis et al., 2000). Further, constructs to employ when measuring the physical environment related to physical activity are also unclear (Sallis, Simons-Morton, Stone et al., 1992).

The physical environment is represented by the objects that the individuals have interaction with (e.g., buildings, parks, roads and equipment). Sallis, Johnson, Calfas, et al. (1997) state that physical environmental factors are the least studied variables when examining physical activity and, since physical environments have the capacity to influence behaviour over a large population, research in this area is imperative.

The Objective Physical Environment Related to Physical Activity

In respect to the objective physical environment, one study with youth and one study surveying adults have examined the observed environment and physical activity. The study with youth (Johns & Ha, 1999) found that students in Hong Kong spent more time being active in a school setting during free playtime than in a small, adult-controlled home setting. Brownson and colleagues' (2000) research with adults reported that an increase in the construction of physical environments supportive of physical activity (i.e., walking trails) was related to increased physical activity, especially for persons who were more sedentary or were in lower socioeconomic status groups.

The Perceived Physical Environment Related to Physical Activity

To date, only one published study has examined perceived physical environments related to physical activity among youth (Sallis et al., 1997). This study examined physical environmental variables (i.e., equipment & facilities related to physical activity) in the home environment, neighbourhood environment and at convenient facilities. The researchers assessed three physical activity measures, including minutes of walking per week, frequency of strength exercises, and frequency of vigorous exercise. After

controlling for demographic variables (e.g., socioeconomic status, age, sex) a small variance (7%) was explained by the environmental variables which was only apparent when predicting strength exercises. In the models that employed walking and vigorous exercise as dependent outcomes, no variance was explained by the environmental variables when controlled for by demographic characteristics.

Perceived versus Objective Physical Environments Related to Physical Activity

Both the perceived and objective physical environments may be related to physical activity. However, it is useful to know the magnitude of congruence between the perceived and objective measures. Since studies may use perceived measures because they are less expensive and easier to assess via a self-report questionnaire (Blair, 1984; Armstrong & Welsman, 1997; Freedson & Melanson, 1996), a small difference in score between the perceived and objective assessments would justify employing perceived measures. On the other hand a large difference between perceived and objective scores would mean that employing the perceived rather than the objective measures may result in invalid findings.

Additionally, investigation on differing perceptions with respect to actual phenomena can provide insight as to how individuals may bias their own personal risk. Rothman, Klein & Weinstein (1996) explored this relationship over many health issues (e.g., suicide, alcohol abuse and obesity) and concluded that, while it may be difficult to predict perceived risk of one behaviour from another, individuals consistently over- or under-estimate risk with respect to a single health issue. For example, if a person underestimates their risk of a heart attack, that underestimation will be consistent over

various tests. However, predicting that person's perceived risk assessment for another cardiovascular disease is not possible based solely on their prediction of a heart attack. The physical activity literature has not addressed the relationship between perceived and objective assessments and there exist calls for such research to be completed (Sallis et al., 1992; Sallis & Owen, 1997; Sallis et al., 2000) in the interest of physical activity promotion.

The purpose of this study is to determine the relationship between objective and perceived measures of the physical environment. The first objective is to establish if students can accurately perceive their objective school physical environments. The second objective is to examine the factors which differentiate between students who accurately and inaccurately perceive objective school environments that can promote physical activity.

METHODS

Subjects & Response Rates

Subjects were rural Alberta high school students in grades nine to twelve in four high schools. The total population of the four schools was 1595 students; however researcher access to classes was limited by the school principals. Thus, a total of 1291 students were eligible for participation, of which 914 completed the instrument, resulting in a 71% response rate (914/1291). Of the 914 cases, 64 were deleted from the analysis because of missing data. Therefore, the sample size for this study was 850. Approximately 41% of the sample were male, and a relatively even distribution among

grades 9 through 12 was observed (22% grade 9, 28% grade 10, 25% grade 11, 25% grade 12).

Measures

Objective Physical Environment Related to Physical Activity Audit Tool

We developed an objective school physical environment measure based on a set of criteria regarding the planning, designing and operating of athletic facilities for high schools and universities (Spoor, Cox & Brown, 1998) and information from various facility planning guides (i.e., Farmer, Mulrooney & Ammon, 1996; Flynn, 1993). In an attempt to ensure an accurate representation of the existing Alberta school facilities policy, the most recent published government source (the Alberta Department of Culture, Youth and Recreation, Recreation Area and Facility Planning Guide; Turik, 1971) was also consulted.

The objective audit tool was broken down into seven domains including: gymnasiums, equipment, pool, fields, arenas, change rooms and showers, and accessibility. A scoring system was developed producing a score out of ten for each domain. These scores were summed and converted to a total school environment score out of ten. For the areas of gymnasiums, pool, fields, arenas and accessibility, 'Yes/No' responses were solicited. For the section on equipment, the number of each type of equipment was considered in the calculation; with a greater amount of equipment yielding a greater score. For the section on change room and showers a rating system was developed based on classifications of odour, cleanliness, and space. This measure was expert tested with three physical educators in Alberta and changes were made based

on these suggestions and from a pilot study with 30 high school students prior to the objective environmental assessment of the study proper. The inter-rater reliability of the audit tool was high (r = .89).

Perceived Physical Environment Related to Physical Activity Measure

The assessment of the students' perceived physical school environment related to physical activity was accomplished by employing a set of visual analogue scales where subjects responded to statements by placing an 'X' along a line rated zero (disagree completely) to ten (agree completely). Examples of the items include: "The gym space allows me to do all the activities I want."; "The sport or exercise equipment works well."; and "The athletic facilities at my school are easily accessible to me." The perceived school environment scores were summed and converted to a score out of ten. Expert testing with physical education teachers and academics was conducted to ensure that the items of the perceived physical environment measure paralleled the items on the objective physical environment audit tool.

Other Measures

Major demographic, cognitive and social factors often associated with physical activity in youth (Sallis et al., 2000; Taylor & Sallis, 1997) were also assessed. The demographic variables included sex (males=1; females=2) and age (grade 9=1; grade 10=2; grade 11=3; grade 12=4). The cognitive factor of physical activity self-efficacy was assessed as the mean of five items (e.g., "How sure are you that you can get up early, even on weekends, to exercise?"; "How sure are you that you can set aside time for

regular exercise?"). Each of five self-efficacy situations was responded to as 'I'm sure I can't' (1), 'Unsure' (2), or 'I'm sure I can' (3). Social variables were assessed by three one-item measures. Peer and family networks were measured on four point scales (none=1, all=4) based on the response to two questions: "How many of you closest friends participate in physical activity?" and "Not counting yourself, how many people in your home participate in physical activity?". Physical education teacher relationship was measured with a five-point response option (not at all=1; very much=5) to the question "Since grade 8, how much have you liked your PE teacher?". The physical activity measure was based on the estimation equation of energy expenditure reported in the Canada Fitness Survey (Fitness & Amateur Sport, 1983; Weller & Corey, 1998). Subjects self-reported the frequency and duration of moderate and hard physical activity over the period of one week. These scores were multiplied with a summary metabolic equivalent score for each intensity level to create energy expenditure scores. The sum of moderate and hard intensity energy expenditure scores created an estimation of the energy expenditure.

Procedure

Schools were selected through the appropriate protocols established by university and school district policies. After permission was received from the superintendents of the various school districts and the principals of the schools, a package including the questionnaires, pupil and parental/guardian consent forms, and teacher information sheets, were sent to each school. Each student was provided with informed consent, from

the principal of the school, and told that they may remove themselves from the study at any time without any consequences.

On a mutually agreed upon date chosen by the school principal and the researchers, two observers distributed and collected the questionnaires. The classroom teachers supervised the completion of the questionnaires; however, the observers were available in the school to answer any questions that may have arisen. The questionnaire took approximately 45 minutes to complete.

Following the collection of the completed questionnaires, the two research observers were led on a tour of the school facilities by either the principal or a physical education teacher, at which time the objective measurement tool was completed independently by each observer. Questions were asked of the tour guide by the observers in order to ensure the entire objective instrument could be completed accurately.

Data Analysis

First, a *difference score* was calculated by subtracting the perceived physical environment score from the objective physical environment score. Thus, a negative score represented a perception that the environment afforded greater opportunity for physical activity and a positive score represented a perception of fewer opportunities for physical activity. A histogram (see *Figure 1*) of the difference scores was produced and natural break-points were visually determined based upon where changes in the histogram column size occurred. Using these natural break-points three groups were created: *perceive greater*, *perceive same*, and *perceive fewer* groups. A discriminant function analysis was performed on the total sample using age, self-efficacy, peer network, family

network, teacher relationship and energy expenditure as predictors of membership in the three groups. Given that activity levels differ between boys and girls (Allison & Adlaf, 1997) subsequent discriminant anlyses were performed separately by sex to explore some of these possible differences.

RESULTS

The collected data showed small variability on the objective assessment between schools, as all scores fell within a one point range (lowest score = 5.55, highest score = 6.56). The perceived measure demonstrated high variability with scores throughout the possible range (zero to 10). The ranges of differences are shown on the historgram plot (*Figure 1*).

On examination of a histogram plot of the difference scores (*Figure 1*), the natural break-points for the groupings appeared to be at –1.50 and 2.50. Therefore, the *perceive greater* group consisted of those subjects whose difference scores fell below –1.50, the *perceive fewer* group consisted of those subjects whose difference scores were greater than 2.50, and the *perceive same* group consisted of those subjects whose difference scores were between the natural break-points. Thus, the total sample the group membership sizes were 131, 581 and 138 respectively for the perceive greater group, the perceive fewer group and the perceive same group (*Table 1*). For males the group membership sizes were 70, 50 and 221, and for females the group membership sizes were 61, 88 and 360 for the perceive greater group, the perceive fewer group and the perceive same group respectively. The overall mean difference score (i.e., objective minus perceived) was 0.37.

Figure 1 & Table 1 About Here

The results for the combined sexes demonstrated that differences between the groups with respect to age were not significant while those with lower self-efficacy ($F = 5.31$, $p<.01$) and a smaller peer network with respect to physical activity ($F = 5.09$, $p<.01$) were more likely to be in the perceive fewer rather than the perceive same or perceive greater groups. With respect to family network ($F = 2.97$. $p=.05$) for the combined sexes, those with smaller networks were more likely to be in the perceive fewer rather than the perceive greater group. Larger teacher relationship ($F = 43.8$, $p<.01$) and energy expenditure ($F = 10.4$, $p<.01$) scores pointed towards a greater likelihood to be in the perceive fewer or perceive same groups as compared to the perceive greater group (*Table 1*).

The separate sex discriminant analyses revealed that for males those with lower self-efficacy related to physical activity ($F = 3.29$, $p<.05$), fewer family members participating in physical activity ($F = 2.70$, $p<.07$), a larger dislike of their physical education teachers ($F = 19.6$, $p<.01$) and lower energy expenditure per week ($F = 4.62$, $p<.01$) were more likely to be in the perceive fewer or perceive same groups as compared to the perceive greater group. For females the analysis showed that lower energy expenditures per week ($F = 3.76$, $p<.05$), fewer friends participating in physical activity

($F = 3.08$, $p<.05$) and lower regard for their physical education teachers ($F = 21.4$, $p<.01$) were more likely to be in the perceive fewer group as compared to the perceive same or perceive greater groups.

The results from the discriminant analysis found two significant functions when the total sample was considered but only one significant function to predict group membership for males and females separately (*Table 2*). For the total sample, the first function explained 89.1% of the variance and the second function explained the remaining 10.9% of the variance. Each function demonstrated a strong association between groups and the predictors [$\chi^2_1(12)= 113.0$, $p<.01$; $\chi^2_2(12)= 13.0$, $p=.02$]. The sole function for boys explained 85.7% of the variance and the function for girls explained 90.6%. For both sexes the function also demonstrated a strong association between the groups and the predictors [$\chi^2_{males}(12)= 54.0$, $p<.01$; $\chi^2_{females}(12)= 55.9$, $p<.01$].

Table 2 About Here

According to the group centroids (*Figure 2*) the first function distinguished the perceive greater group from the perceive same group and the perceive fewer group, while the second discriminate function maximally separated those in the perceive same group from the perceive fewer and perceive greater groups. Since only one function was

significantly associated with the groups and predictors for males and females this function equally explained the prediction for each group.

Figure 2 About Here

The cannonical correlations of predictor variables with discriminant functions (*Table 3*) found the best predictor of those who are in the perceive better group are the subjects that have a better relationship with their physical education teacher (r_c = .91)*. Additionally those who were more active (r_c = .42) were also more likely to be in the perceive better group. However, a negative relationship was also found for energy expenditure with respect to the second function (r_c = -.37) demonstrating that those who are less active will more likely perceive the physical environment different than the objective assessment. As well, those with larger peer networks (r_c = .63) and a higher self-efficacy (r_c = 41) will be more likely to perceive the physical environment as different than shown by the objective measure.

Table 3 About Here

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*r_c= canonical correlations of predictor variables with discriminant functions

For both male and female students the canonical correlations of predictor variables with discriminant functions (*Table 4*) found that greater scores on teacher relationships ($r_{c,\ male}$=.88; $r_{c,\ female}$=.90) and energy expenditure ($r_{c,\ males}$ = .40; $r_{c,\ females}$ = .37) led to membership in the groups which rated the environment better than the objective assessment. For the male subsample was it also demonstrated that more family members participating in exercise (r_c = .33) and a higher self-efficacy related to physical activity (r_c = .32) were associated with perceptions that rated the environment better than the objective measure. By convention, canonical correlations less than .30 were not interpreted (Tabachnick & Fidell, 1989).

Table 4 About Here

The two functions using the total sample correctly predicted 578 (68.0%) of the cases (*Table 5*) which is more than expected by chance (436.8 or 51.4%). The function for boys correctly predicted 220 (64.5%) of the cases while the function for the girls correctly classified 359 (70.5%) of the cases. Although 64.5% of the males (i.e., 220 out of 341; from *Table 1*) and 70.7% of the girls (i.e., 360 out of 509; from *Table 1*) actually perceived the physical environment the same as the objective environment, the classification scheme using sample proportions as prior probabilities, classified 96.8% of the boys and 99.7% of the girls as perceiving the same as the objective. This means that those in the perceive same group were more likely to be classified correctly than either

the perceive greater (10.0% and 0% correct classification for boys and girls respectively) or the perceive fewer group (0% classified correctly for both sexes). Similar results were apparent in the total sample results.

Table 5 About Here

DISCUSSION

To date, this is the first study that has examined the relationship between the perceived and objective physical environments with respect to physical activity in a school setting. This study was a response to the call in the literature to examine the above relationships (Sallis et al., 2000; Sallis & Owen, 1997; Sallis et al., 1992).

The small mean difference score (0.37) reported in this study's first objective leads to the conclusion that using perceptual measures rather than an objective measure, when examining the physical activity related physical environments, would still provide valid results. This has an important implication due to the generally lower cost, easier implementation and convenience of self-report questionnaires when compared to objective measures (Armstrong & Welsman, 1997; Freedson & Melanson, 1996). Therefore, our findings support the use of either perceptual or objective measures for future similar studies, whichever is most convenient and appropriate for the particular research.

There are a number of major findings with respect to the second objective of this study. For both the male and female subgroups, subjects who had positive relationships

with their physical education teachers were more likely to perceive the physical environment as better than the objective measure.

Peer network for the total sample discriminated between those individuals who perceived the physical environment as greater or less than the objective environment from those individuals who perceived the physical environment as the same as the objective environment. This finding is intuitive because in early adolescence individuals begin to identify themselves with a peer group (Newman & Newman, 1995). Thus, the recommendation that interventions could be targeted at the peer group level rather than the individual level can be inferred. Additionally, group level intervention results may be more easily generalised over many peer groups while findings at the individual level (i.e., individual knowledge and attitudes) may not be as easily generalised over those same peer groups.

Another insight from the above findings is that physical and social environments are inter-related. For example, the result that physical education teacher relationship was associated with positive perceptions of the environment, demonstrates that a positive social environment might create a positively perceived physical environment. Theoretical support for this assertion is available from ecological approaches. The underlying principle of an ecological approach is the interaction between organisms and their living and nonliving environments (Curtis & Barnes, 1989).

Evans & Evans (1987) propose a model to capture the essence of an ecological approach that includes the three environmental subdomains of the biophysical, the physical, and the psychosocial. The biophysical environment includes the individual factors that may affect behaviour such as dealing with an illness, being on medication,

having allergies, or even genetic influences. The physical environment includes such variables as space, technology, air quality, and others. The psychosocial environment includes dimensions of culture, peer network, family network, and social cognitive components like locus of control and self-efficacy. Along with these environmental interactions, models specific to the area of health promotion (i.e., McLeroy et al, 1988; Richard et al., 1996) suggest that interactions between various levels exist. Richard et al. (1996) propose a hierarchy of social systems (i.e., groups, organisations, communities, societies and supranational systems) within which the environments each exist. Longitudinal studies are necessary to test the dynamic interactions between the various environmental domains (e.g., physical, psychosocial, behavioural and social levels).

Another major finding was that those individuals (including the male and female subsamples) who were more active were also more likely to perceive the physical environment as better than those who were less active. These results are consistent with the Social Cognitive Theory principal of *reciprocal determinism*. Reciprocal determinism is defined as the existence of dynamic interactions between the person, the behaviour, and the environments in which the behaviour is performed (Baranowski, Perry & Parcel, 1997). Furthermore, these dynamic interactions are reciprocal in nature, meaning that the person, the behaviour and the environments each influence the other two constructs. Thus, physical activity behaviour should affect the perception of the physical environment and vice-versa. Therefore, it can be inferred that those who are active within a physical environment context should perceive that environment as better because it provides the opportunity to be highly active. Further longitudinal testing of the

relationship between the person, the behaviour and the physical environment is necessary to determine the specific mechanisms at work with respect to physical activity behaviour.

Physical activity self-efficacy was also found to discriminate between individuals in the perceive same group with those in the other two groups. Self-efficacy is defined as one's perception of their own capabilities (McAuley, 1994), which change as an individual succeeds or fails at accomplishing specific goals (Kavussanu & Roberts, 1996). Thus, it is intuitive that an individual with higher self-efficacy would not need to perceive the physical environment differently as he or she would perceive a high ability to be physically active in the existing environment.

The results of the discriminant analysis found that self-efficacy was correlated above .30 for the male, but not the female, subsample. A possible explanation for this difference is that there exists distinct mechanisms for boys and girls through which self-efficacy influences physical activity. This explanation could be supported by studies by Kavussanu & Roberts (1996) and Allison, Dwyer & Makin (1999) both of which demonstrate sex differences on self-efficacy related to physical activity.

The discriminant analysis also revealed the result that a larger family network was related to greater perceptions of the physical environment. This result was unique to the male subsample. One rationalisation of this result is that boys interact differently in the family with respect to physical activity. Indeed, Wold & Anderssen (1992) found that the physical activity of boys is influenced more by the father's behaviour than by the mother's behaviour. Additionally, Arnio and collegues (1997) reported that fathers who were very active had stronger associations with highly active boys than highly active girls. Further, recent Canadian data demonstrate that men are more active than women

(Canadian Fitness & Lifestyle Research Institute, 1998). These studies imply that fathers' physical activity may be more influential on sons than daughters. Since fathers are more likely to be active than mothers, and boys may be influenced more by active fathers than are girls, then it is intuitive that boys should be more active than girls. Further, in accordance with the results from the discriminant analysis, an individual who is more active is also more likely to perceive the environment affording greater opportunities. Therefore, the result that males in our subsample were more likely to be predicted into the perceive greater group is logical.

Our results also provide direction for future research. The measures of teacher relationship, peer network, physical activity level, self-efficacy could be used to determine over- or under-estimations of perceived environmental assessments. For example, in a sample that reports positive perceptions towards a physical education teacher, objective measures of the physical environment might also need to be employed to ensure that an over-estimation of the physical environment was not occurring. Indeed, the results of our study found positive perceptions towards physical education teachers predicting subjects into the perceive greater group.

Another implication of these findings is that focusing physical activity interventions on changing the students' perceptions may prove powerful. Our results demonstrated the trend that individuals who perceived the environment to afford greater opportunities were more likely to be active. Therefore, changing individual perceptions of the environment may also lead to a greater amount of physical activity.

Our study found that approximately 68% of the subjects perceived the school physical environment related to physical activity similar to the objective school physical

environment measure. These results differ from those seen in two other studies comparing perceived and objective measures. In a study of safe sitting distance away from the steering wheel of an automobile while driving Segui and colleagues (1999) found that 74% of the subjects perceived similarly to the objective. Another study, examining perceived and objective risk of a heart attack, 43% of the subjects perceived correctly (Niknian, McKinlay, Rakowski & Carleton, 1989). The three different results demonstrate the importance of examining objective and perceived measures separately for each construct or health behaviour. This conclusion is also supported by Rothman et al. (1996) who report inconsistencies between and within health domains.

There were a number of limitations in this study which need to be acknowledged. First, the questionnaire took approximately 45 minutes to complete, which might have been a limitation for some students with poor literacy skills or attention deficit characteristics. Second, due to the multi-step consent protocol the study is a convenient rather than a random sample of rural Alberta high school youth. Caution must be given in generalizing these findings outside of this context. The final limitation is the cross-sectional design of the study which was due to the complexities, time, and expense of conducting a longitudinal study. Thus, causation of the study's findings cannot be implied.

Further natural observation studies using longitudinal designs examining the role of a changing environment over time within the scope of what is valued by the population of interest, must be completed. Additionally, randomised controlled trials with actual manipulations of the physical environment may also be helpful in furthering our understanding of the relationship between physical activity and the physical environment.

Research regarding the stability of perceptions over time and various conditions must also be completed in order to conclude that objective and perceived measures are congruent. Finally, replicating this study in multiple contexts (e.g., home and community environments) is necessary, as each environment might be different from the school context examined in this study.

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Table 1. Descriptive statistics for the three groupings

	Groups			Combined Groups Score	Wilks' Lambda	F**
	Perceive Greater	*Perceive Same*	*Perceive Fewer*			
# of Male Cases	70	220	51	341		
# of Female Cases	61	360	88	509		
# of Total Cases	131	581	138	850		
% of Total Grouped Cases	15.4	68.4	16.2	100.0		
Total Group Mean Difference Score (SD)	-2.33 (0.62)	0.28 (0.96)	3.12 (0.95)	0.37 (1.80)		
Male Means (SD)						
• Age$_a$	3.70(1.32)	3.83(1.27)	3.82(1.20)	3.80(1.27)	0.998	0.29
• Self-efficacy$_b$	2.34(0.53)	2.27(0.52	2.09(0.59)	2.26(0.54)	0.981	3.29¯
• Family Network$_a$	2.49(1.14)	2.22(1.07)	2.04(1.08)	2.25(1.09)	0.984	2.70
• Peer Network$_a$	2.67(0.65)	2.70(0.77)	2.47(0.76)	2.66(0.75)	0.989	1.89
• Teacher Relationship$_c$	4.11(1.06)	3.39(1.23)	2.75(1.29)	3.44(1.27)	0.896	19.6*
• Energy Expenditure$_d$	1868.4 (1116.3)	1465.2 (935.6)	1427.6 (1152.9)	1542.3 (1019.8)	0.973	4.62*
Female Means (SD)						
• Age$_a$	3.38(1.25)	3.53(1.20)	3.60(1.28)	3.52(1.22)	0.998	0.62
• Self-efficacy $_a$	2.32(0.44)	2.30(0.43)	2.19(0.45)	2.28(0.44)	0.991	2.24
• Family Network$_a$	2.44(1.06)	2.39(1.11)	2.20(1.05)	2.37(1.10)	0.995	1.20
• Peer Network$_e$	2.44(0.72)	2.49(0.66)	2.30(0.59)	2.45(0.66)	0.988	3.08¯
• Teacher Relationship$_c$	3.79(1.16)	3.14(1.20)	2.50(1.17)	3.11(1.24)	0.922	21.4*
• Energy Expenditure$_b$	1433.0 (802.7)	1212.7 (852.1)	1053.8 (755.3)	1211.7 (834.9)	0.985	3.76¯
Total Means (SD)						
• Age$_a$	3.55(1.30)	3.64(1.24)	3.68(1.25)	3.64(1.25)	0.999	.42
• Self-efficacy$_f$	2.33(0.49)	2.29(0.47)	2.16(0.50)	2.27(0.48)	0.988	5.31*
• Family Network$_b$	2.47(1.10)	2.33(1.10)	2.14(1.06)	2.32(1.10)	0.993	2.97^
• Peer Network$_f$	2.56(0.69)	2.57(0.71)	2.36(0.66)	2.53(0.70)	0.988	5.09*
• Teacher Relationship$_c$	3.96(1.11)	3.23(1.22)	2.59(1.22)	3.24(1.26)	0.906	43.8*
• Energy Expenditure$_d$	1665.6 (1003.2)	1308.5 (892.4)	1191.0 (934.8)	1344.3 (927.3)	0.976	10.4*

PF = perceive fewer group, PS = perceive same group, PG = perceive greater group; * $p<0.01$, ¯$p<0.05$, ^ $p=0.05$, ** df (2, 338) for males; df (2, 506) for females; and df (2, 847) for total

Post-hoc ANOVAS ($p < .05$): a = No difference; b = PF<PG; c = PF<PS<PG; d = PF, PS<PG; e = PF<PS; f = PF<PS, PG

Table 2. Canonical Discriminant Functions

Function	*Eigenvalue*	*% Variance*	*Canonical Correlation*	*After Function*	*Wilks' Lambda*	*Chi-square*	*df*
				Males			
				0	0.85	54.0*	12
1	0.14	85.7	0.36	1	0.98	8.11	5
2	0.02	14.3	0.16				
				Females			
				0	0.89	55.9*	12
1	0.11	90.6	0.31	1	0.99	5.46	5
2	0.01	9.4	0.10				
				Total			
				0	0.87	113.0*	12
1	0.13	89.1	0.33	1	0.98	13.0**	5
2	0.02	10.9	0.12				

*p<.01, ** p<.05

Table 3. Results of discriminant function analysis of *perceived difference* of the physical environment for the total sample

Predictor Variable	Correlations of predictor variables with discriminant function		Pooled within-group correlations among predictors				
	1	*2*	*Self-efficacy*	*Family Network*	*Peer Network*	*Teacher Relationship*	*EE*
Total							
Age	-0.09	0.06	-0.07	-0.08	-0.15	0.07	-0.07
Self-efficacy	0.28	0.41		0.15	0.20	0.13	0.33
Family Network	0.23	0.14			0.22	-0.02	0.21
Peer Network	0.22	0.63				0.10	0.31
Teacher Relationship	0.91	0.12					0.06
Energy Expenditure	0.42	-0.37					

Table 4. Results of discriminant function analysis of *perceived difference* of the physical environment for males and females

Predictor Variable	Correlations of predictor variables with discriminant function	Pooled within-group correlations among predictors				
	1	*Self-efficacy*	*Family Network*	*Peer Network*	*Teacher Relationship*	*EE*
Males						
Age	-0.09	-0.15	-0.10	-0.17	0.01	-0.09
Self-efficacy	0.32		0.16	0.28	0.17	0.31
Family Network	0.33			0.20	-0.03	0.27
Peer Network	0.14				0.20	0.33
Teacher Relationship	0.88					0.10
Energy Expenditure	0.40					
Females						
Age	-0.15	0.01	-0.06	-0.16	0.09	-0.08
Self-efficacy	0.26		0.14	0.15	0.10	0.36
Family Network	0.19			0.26	0.00	0.19
Peer Network	0.23				-0.00	0.26
Teacher Relationship	0.90					0.00
Energy Expenditure	0.37					

EE = energy expenditure

Table 5. Classification matrix

Males		Predicted Group Membership		
Actual Group	**No. of Cases**	***Perceive Greater***	***Perceive Same***	***Perceive Fewer***
Perceive Greater	70	7 10.0%	63 90.0%	0 0%
Perceive Same	220	7 3.2%	213 96.8%	0 0%
Perceive Fewer	51	2 3.9%	49 96.1%	0 0%
Percent of grouped cases correctly classified			64.5%	

Females		Predicted Group Membership		
Actual Group	**No. of Cases**	***Perceive Greater***	***Perceive Same***	***Perceive Fewer***
Perceive Greater	61	0 0%	61 100%	0 0%
Perceive Same	360	0 0%	359 99.7%	1 0.3%
Perceive Fewer	88	0 0%	88 100%	0 0%
Percent of grouped cases correctly classified			70.53%	

Total		Predicted Group Membership		
Actual Group	**No. of Cases**	***Perceive Greater***	***Perceive Same***	***Perceive Fewer***
Perceive Greater	61	4 3.1%	127 96.9%	0 0%
Perceive Same	360	6 1.0%	574 99.0%	1 0.3%
Perceive Fewer	88	1 0.7%	138 99.3%	0 0%
Percent of grouped cases correctly classified			68.0%	

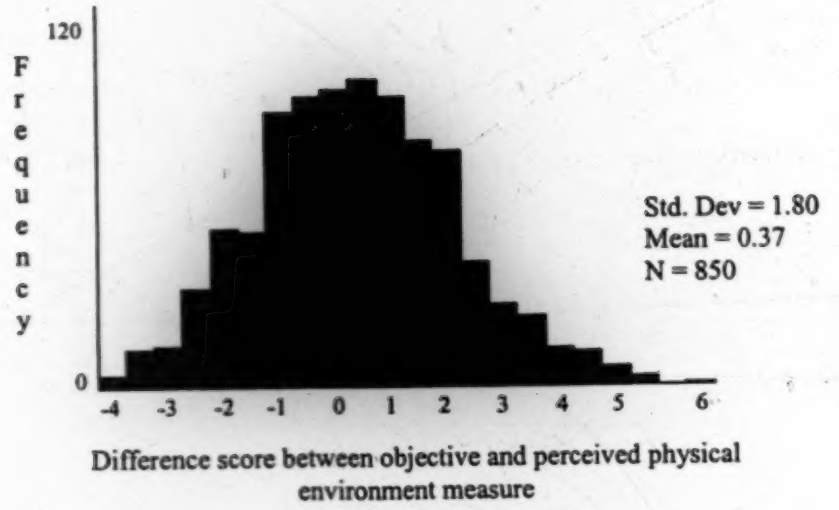
120
Frequency
0
-4 -3 -2 -1 0 1 2 3 4 5 6
Std. Dev = 1.80
Mean = 0.37
N = 850
Difference score between objective and perceived physical environment measure

Figure 1. Histogram of *difference* scores

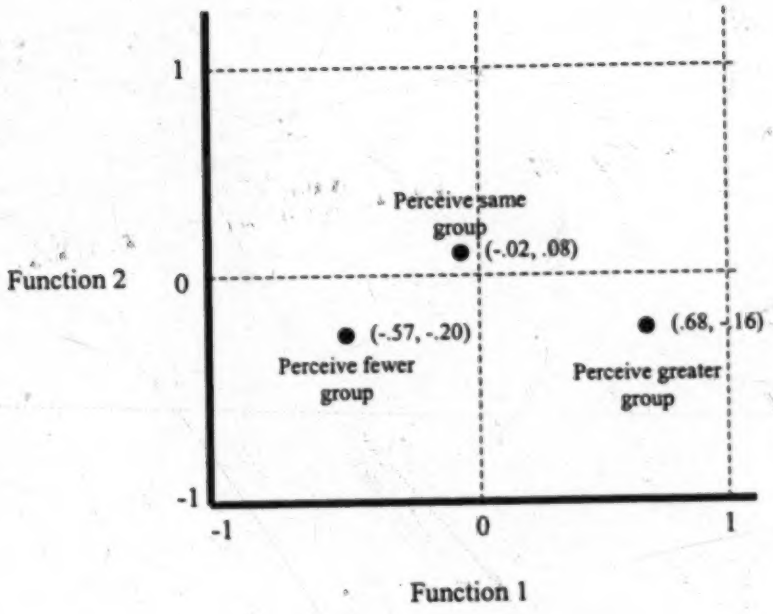

Figure 2. Plot of group centroids of the two significant discriminant functions for the total sample

CHAPTER 3 – PAPER #2

The Relationship Between the Perceived Physical Environment, the Perceived Importance of the Physical Environment and Physical Activity in Youth

A.J. Fein[1], R.C. Plotnikoff[2], T.C. Wild[3], J.C. Spence[4]

[1]Centre for Health Promotion Studies, University of Alberta, Canada
[2]Centre for Health Promotion Studies, Alberta Centre for Well-Being, Faculty of Physical Education, University of Alberta, Canada
[3] Centre for Health Promotion Studies, University of Alberta, Canada
[4] Alberta Centre for Well-Being, Canada

Abstract

The aim of this study was to explore the relationship between the perceived physical environment, the perceived importance of the physical environment and physical activity in youth. A self-report questionnaire was completed by 610 male and female high school students in four schools in rural Alberta, Canada. With energy expenditure as the dependent measure, two multiple regressions were completed: one with perceived physical environment constructs as independent variables and one with perceived importance of the physical environment as independent variables. The perceived physical environment constructs explained 5% of the variance with the home ($\beta = .13$, $p<.01$), neighbourhood ($\beta = .08$, $p<.01$) and school ($\beta = .13$, $p<.01$) environments being significantly associated with physical activity. The perceived importance constructs explained 8% of the variance and only the school context ($\beta = .22$, $p<.01$) showed a significant relationship. Additionally, a hierarchical regression was completed, entering the variables of sex, grade, self-efficacy, peer network, family network and teacher relationship as the first block and eight environmental constructs as the second block. The first block variables accounted for 22% of the variance and environmental constructs accounted for an added 4% of the variance for physical activity. The perceived importance of the school environment was significantly associated with physical activity ($\beta = .14$, $p<.01$). The other perceived environment and perceived importance variables were not significantly related to physical activity in the adjusted hierarchical model. Longitudinal studies are required to further explore causal relationships among environmental variables and physical activity in youth.

Keywords: ***perceived physical environment, physical activity, youth***

Introduction

Since the beginning of the 20th century scientists have been examining the relationship between physical activity and health. Some of the benefits associated with physical activity include the reduction of risk for cardiovascular disease, certain types of cancer, diabetes and osteoporosis, along with an increase in the ability to handle many life stresses (Blair, Brill, & Barlow, 1994; Greenberg, 1996; US Department of Health and Human Services, 1996). Studies have also demonstrated that positive physical activity experiences in childhood can improve intrapersonal and interpersonal factors such as self-concept and self-esteem, social acceptance, and even romantic appeal (Malina, 1994; Calfas & Taylor, 1994; Allison & Adlaf, 1997). However, recent studies show that only 33% of Canadian adolescents are considered active enough for optimal health benefits (Canadian Fitness & Lifestyle Research Institute, 1998). Further, this percentage is reduced to only 25% for girls when examining the sexes separately (Canadian Fitness & Lifestyle Research Institute, 1998). Since physical activity is so important to health and well-being there is a great need to examine how to promote increased participation in youth.

Many theories have been advanced to describe physical activity behaviour. For example, social-cognitive theories such as the Theory of Planned Behaviour (Godin & Kok, 1996) and the Transtheoretical Model (Prochaska & Marcus, 1994) have been utilised to explain and predict physical activity behaviour. These approaches have demonstrated limited results (Sallis & Owen, 1997), however ecological approaches (McLeroy, Bibeau, Steckler & Glanz, 1988; Richard, Potvin, Kishchuk, Prlic & Green, 1996) though more complex, conceptually show promise in explaining the multiple factors influencing physical activity behaviour (Sallis & Owen, 1997). The *Physical*

Environment and Physical Activity Model (PEPA Model) is a heurestic by which the relationship between the physical environment and physical activity can be examined.

As seen in *Figure 1*, the key components of the PEPA Model are the *perceived physical environment related to physical activity*, the *perceived importance of the physical environment related to physical activity*, and *physical activity*. Major correlates of physical activity for youth are also considered in the PEPA Model (i.e., sex, age, self-efficacy, peer support, family support and physical education teacher relationship).

Figure 1 about here

An underlying assumption of all ecological models is that there is a dynamic interplay between an individual and the environment in order to produce a behaviour (Catton, 1994). The two-headed arrows in *Figure 1* depict the bidirectional nature of relationships in ecological approaches and the principle of reciprocal determinism from Social Learning Theory (Baranowski, Perry & Parcel, 1997). The solid arrows in the figure will be tested in this study while the relationships represented by the clear arrows should be examined in future studies.

Additional justification of the relationship between the environment constructs can be gathered from the Health Belief Model (HBM; Rosenstock, 1990). The key constructs from the HBM that pertain to the PEPA Model are *perceived barriers* and *cues to action*. In this case, the physical environment related to physical activity can be

idealised as a barrier. Specifically, the lack of appropriate and adequate equipment and space will prevent an individual from participating in physical activity. Conversely, appropriate physical environments can facilitate physical activity. The perceived importance of the physical environment and the actual physical environment combine to create cues to action. If an individual perceives an environment as important and then has access to that environment, he or she will be more likely to act. For example, if a student perceives a basketball court as important to him/her and the school has six courts, that student will more likely be active.

Additional correlates of physical activity are important to consider when examining the components of the PEPA Model as they have been shown to influence physical activity behaviour within adolescent populations (Mota & Queiros, 1996; Sallis et al., 1992; Wold & Anderssen, 1992; Gottlieb & Baker, 1986; Sallis et al, 2000; Taylor & Sallis, 1997). Past studies have shown that girls are less active than boys (Canadian Fitness & Lifestyle Research Institute, 1998; Allison & Adlaf, 1997) and that there is a distinct decline of physical activity throughout adolescence (Dishman & Buckworth, 1996; Bungum & Vincent, 1997). There is theoretical and empirical support which demonstrates higher self-efficacy relates to increased activity levels (Kavussanu & Roberts, 1996; Allison, Dwyer & Makin, 1999). Additionally, the social influences of peers, family and physical education teachers are all directly related to physical activity participation as evidenced in a number of studies (i.e., McLellan, Rissel, Donnelly & Bauman, 1999; Godin & Shephard, 1986; Moon, Mullee, Rogers et al., 1999; Leslie, Owen, Salmon et al., 1999; Wold & Anderssen, 1992; Gottlieb & Baker, 1986))

The literature (Sallis, Prochaska & Taylor, 2000; Sallis, Hovell, Hofstetter & Barrington, 1992;Epstein, 1998; Sallis, Johnson, Calfas et al., 1997; Sallis & Owen, 1997; Stone, McKenzie, Welk & Booth, 1998) calls for the development of physical environment measurement tools and the examination of the relationships between physical environment constructs and physical activity across various settings. Therefore, the purpose of this study is to examine the relationship between the perceived importance of the physical environment, the perceived physical environment and physical activity behaviour in high school-aged youth.

METHODS

Subjects & Response Rates

The subjects for this study were rural Alberta high school students in grades nine to twelve in four high schools. The total population of the four schools was 1595 students however, researcher access to classes was limited by the school principals. Therefore, a total of 1291 individuals were eligible, of which 914 completed the questionnaire, resulting in a 71% response rate (914/1291). However, due to missing data a final sample size of 610 cases were subjected to analysis. Approximately 62% of the sample were female, and a relatively even distribution among grades 9 through 12 was apparent (21% grade 9, 28% grade 10, 26% grade 11, 25% grade 12).

Measures

Perceived Physical Environment Measure

The perceived physical environment constructs were assessed by a modified version of the measures developed by Sallis, Johnson et al (1997) which was comprised of three environmental subscales (the home, neighbourhood and convenient facilities). Items for each subscale employed 'Yes'(1) / 'No'(0) response options to statements regarding space (e.g., roads, sidewalks) and equipment (e.g., weights, shoes, tennis raquets) related to physical activity. The sum of the number of 'Yes' answers yielded scores for each environmental context. The home environment (15 items) was scored within the range of zero to 15, the convenient facilities (17 items) summed into a range of zero to 17 and the neighbourhood environment (12 items) produced scores within the range of one to 16. The neighbourhood environment was scored from a minimum value of one because the scale employed 11 'Yes/No' responses and an additional item regarding perceived neighbourhood safety. This question assessed the perceived safety of the neighbourhood (i.e.,"How safe do you feel walking in your neighbourhood during the day?") with five-point Likert-type scale (very unsafe=1; very safe=5).

The Sallis et al. (1997) instrument was modified to include the school physical environment as a fourth context for physical activity. The 12 perceived school environment items were set as visual analogue scales where subjects would respond to a statement by placing an 'X' along a line rated zero (strongly disagree) to ten (strongly agree). Examples of the items included: "The gym space allows me to do all the activities I want."; "The sport or exercise equipment works well."; and "The athletic

facilities at my school are easily accessible to me." The perceived school environment scores were summed and converted to a single score out of ten.

Perceived Importance of the Physical Environment Measure

The perceived importance of the physical environment measure had parallel items with the perceived physical environment measure. For each perceived physical environment item (above) the parallel question "How important is each item to you when deciding to be physically active?" was asked. Responses were completed with five-point Likert-type options (Not at all important=1; Very important=5). Scale means of these responses were calculated for the perceived importance of the physical environment scores for each of the four physical environmental contexts.

Physical Activity Measure

Due to the length of the survey instrument, a simple measure of physical activity was administered as the study's dependent measure. Students provided self-report answers to their number of exercise bouts, and the approximate duration of each of the bouts over the period of one week. A continuous score representing the energy expenditure of each subject for the moderate and hard physical activity intensities, outside of school hours was calculated. The calculation is based on the estimation equation of energy expenditure reported in the Canada Fitness Survey questionnaire (Fitness & Amateur Sport, 1983; Weller & Corey, 1998):

$$EE = (N \cdot D \cdot MET)_{moderate} + (N \cdot D \cdot MET)_{hard}$$

where: EE = energy expenditure in kcal · kg^{-1} · $week^{-1}$

N = number of days of activity in the past week

D = duration in minutes of that activity level

MET = mean metabolic equivalent value for that level of activity in (kcal · kg^{-1} · $minute^{-1}$)

The energy expenditure was calculated for both the *moderate* and *hard* levels as collected in the questionnaire. The intensity levels were defined with examples. Hard physical activity was defined as: "exercise such as jogging, jazz dancing basketball and mountain biking, which increase your heart rate and make you breathe hard and sweat"; and moderate activity was defined as: "lower intensity activities such as walking or bicycling to school and recreational swimming". The frequency questions asked the subjects to report how many days in the past week they participated in activity of each intensity (e.g., 0 days, 7 days). The duration questions offered the subjects six categories of 10 minute intervals to choose from (e.g., 0-9 minutes; 10-19 minutes). The midpoint score in each category was used to calculate the duration (e.g., 4.5 minutes, 14.5 minutes). The MET score used was the mean of the range for each intensity level of physical activity (i.e., $MET_{moderate}$ = 3.95; MET_{hard} = 5.95). These MET score ranges were developed from the *Seven-day Physical Activity Recall* (Blair et al., 1985; Blair, 1984) and have been demonstrated as valid and reliable for eleventh grade children (Sallis et al., 1993). The energy expenditure scores for hard and moderate physical

activity were summed for the total estimated energy expenditure score used as the dependent measure.

Other Measures

Major demographic, cognitive and social factors often associated with physical activity in youth were also assessed. The demographic variables included sex (males=1; females=2) and age (grade 9=1; grade 12=4). The cognitive factor of physical activity self-efficacy was assessed as the mean of five items (e.g., "How sure are you that you can get up early, even on weekends, to exercise?"; "How sure are you that you can exercise even though you are feeling sad or highly stressed?"). Each of five situations was responded to as 'I'm sure I can't' (1), 'Unsure' (2), or 'I'm sure I can' (3). The social variables were assessed by three, one-item measures. The peer and family networks were measured on four point scales (none=1, all=4) based on the response to the questions "How many of you closest friends participate in physical activity?" and "Not counting yourself, how many people in your home participate in physical activity?". Physical education teacher relationship was measured with a five point response option (not at all=1; very much=5) to the question "Since grade 8, how much have you liked your PE teacher?".

Procedure

Schools were selected through the appropriate protocols explicit in university and school policies. After permission was received from the superintendents of the various school districts and the principals of the schools, a package including the questionnaires,

pupil and parental/guardian consent forms, and teacher information sheets, were sent to each school. Each student was provided with informed consent from the principal of the school and told that they may remove themselves from the study at any time without any consequences.

On a mutually agreed upon date chosen by the principal and the researchers, two researchers distributed and collected the questionnaires. The classroom teachers supervised the completion of the questionnaires; however, the researchers were available in the school to answer any questions that may have arisen. The questionnaire took approximately 45 minutes to complete and were first pilot tested to ensure validity with a sample of 30 high school students in Alberta.

Data Analysis

A correlation matrix was produced in order to determine the preliminary relationships between each construct. Two multiple regressions were completed to delineate associations between 1) the perceived physical environments, and 2) the perceived importance of the physical environments.* Data were also subjected to a hierarchical regression with energy expenditure as the dependent measure. The variables of sex, grade, self-efficacy, peer network, family network and teacher relationship were entered as the first block. The eight environmental variables (a perceived physical environment and a perceived importance of the physical environment variable for each of

* Since there was a large number of missing data for the perceived importance constructs, the regressions were completed with and without the missing cases from the perceived importance constructs. No meaningful difference was seen between the two regression results (i.e., largest difference in beta scores was .04 and there was no difference in significant variables) so the analysis using the smaller data set (N=610) was reported.

the four contexts of home, neighbourhood, convenient facilities and schools) were entered as the second block. A correlation between the global perceived physical environment and perceived importance measures was also completed.

RESULTS

The perceived physical environment scores were variable throughout the range allowed by each environmental context. The neighbourhood context ranked the highest (11.4/16 or 71.3% of the maximum score). The next three environmental contexts are perceived at similar levels with convenient facilities (10.0/17 or 58.8% of the maximum score), the school environment (5.7/10 or 57.0% of the maximum score) and the home environment (7.3/15 or 48.7% of the maximum score).

Descriptive statistics and zero-order correlations among each of the variables are presented in Table 1. The perceived importance constructs were all moderately correlated with each other with Pearson r's ranging from .53 to .73 ($p<.01$). The largest correlation with energy expenditure was self-efficacy ($r=.35$, $p<.01$). Further, males ($r=-.17$, $p<.01$), those in lower grades ($r=-.08$, $p<.05$), and those with increased peer networks ($r=.31$, $p<.01$), family networks ($r=.23$, $p<.01$) and physical education teacher relationships ($r=.08$, $p<.05$) were significantly correlated with energy expenditure. Additionally, the physical environments were positively correlated with energy expenditure ($r_{home} = .16$, $r_{neighbourhood} = .16$, $r_{facilities} = .12$, $r_{school} = .15$, $p<.01$) as were the perceived importance scores ($r_{home} = .22$, $r_{neighbourhood} = .16$, $r_{facilities} = .20$, $r_{school} = .27$, $p<.01$).

Table 1 About Here

The correlation between the global perceived physical environment constructs combined and the global perceived importance of the physical environment constructs revealed a moderate association ($r = .43$).

Multiple regression analyses (*Table 2*) found that the perceived physical environments explained 5% of the variance and the perceived importance of the physical environment explained 8% of the variance with respect to energy expenditure. Overall, the home environment ($\beta = .15$, $p<.01$), neighbourhood environment ($\beta = .13$, $p<.01$) and school environment ($\beta = .11$, $p<.01$) were significantly related to energy expenditure. The perceived importance of the school environment ($\beta = .22$, $p<.01$) was the only perceived importance construct significantly associated with energy expenditure.

The hierarchical regression (*Table 3*) revealed that the entire model accounted for 26% of the variance; 22% from the first block [$F(6, 603) = 28.6$, $p<.001$] and an additional 4% from the second block [$F_{change}(14, 595) = 3.95$, $p<.001$]. In the first block, self-efficacy was strongly associated with energy expenditure ($\beta = .30$, $p<.01$), with sex ($\beta = -.15$, $p<.01$), peer network ($\beta = .18$, $p<.01$) and family network ($\beta = .15$, $p<.01$) also being significantly related to the outcome variable. Age and teacher relationship measures were not associated with energy expenditure. The second block analysis revealed that perceived importance of the school environment was the only

environmental measure showing a significant association (β = .14, $p<.01$) with energy expenditure. The correlates of physical activity which were reported to be significant from the first block analysis were also significant in this analysis ($\beta_{self\text{-}efficacy}$ = .27, β_{sex} = -.16, β_{peer} = .16, β_{family} = .13, $p<.01$).

Table 2 About Here

DISCUSSION

The purpose of this study was to examine the relationships between the perceived physical environment, the perceived importance of the physical environment and physical activity over four environmental contexts. The multiple regression using energy expenditure as the dependent variable and the physical environment constructs as independent variables revealed a significant relationship between physical environments and physical activity. The only environmental context tested that was not significantly related to energy expenditure was *convenient facilities*. A possible explanation for this lack of association may be that other environments (e.g., home and school) might actually be convenient facilities and therefore, consume the variance that would otherwise be explained by the convenient facilities construct.

The multiple regression between the perceived importance of the physical environment constructs also explained a small portion of the variance for energy expenditure. In this case only the school environment context was shown to be

significantly associated with physical activity. This may have been due to a measurement issue, as the school environment might have been more specifically assessed than the other three environments.

Findings from the hierarchical regression are congruent with previous results by Sallis et al. (1997), who also reported mostly non-significant relationships between the objective presence or absence of equipment and opportunities to be active and actual physical activity. The only significant finding in the Sallis et al. (1997) study was an association between home environment and strength exercises, a relationship not tested in the current study. The addition of the school physical environment scale to the existing instrument did not demonstrate significant findings.

These non-significant results of the relationships between the physical environments and physical activity can be interpreted by a lack of clear understanding of the mechanism and extent to which physical environments and physical activity inter-relate. *Figure 2* is one possible mechanism, based on a number of theoretical and empirical underpinnings, through which these constructs might be associated. First, there may exist a minimum level (i.e., a threshold) of the physical environment that is necessary to encourage physical activity. Each school in our study had similar environments and the physical activity levels in each school were also homogeneous. Therefore, a threshold level of the physical environment may have been reached by all of the schools and may have caused a plateau in physical activity levels. Further, it can be hypothesised that there may be many increases and plateaus within a scope of changing environments. In the figure there are three inter-relating environments (e.g., physical, biophysical, psychosocial) which have associations within themselves and between each

other over multiple time periods. It is these dynamic relationships and inter-relationships that should be tested in different schools with very diverse physical environments in order to determine the validity of this interpretation.

Figure 2 About Here

Additional theoretical support for the relationship between the physical environment and physical activity may be found in Social Cognitive Theory. Specifically the notion of *reciprocal determinism* has implications for our model. Reciprocal determinism is defined as the existence of dynamic interactions between the person, the behaviour, and the environments in which the behaviour is performed (Baranowski et al., 1997). Therefore, environments must change over time in order to continually influence physical activity. This relationship should also be reciprocal in nature, whereby as the environments change physical activity will change, which in turn will have an effect on the physical environment. Additionally, the process can occur over multiple environmental contexts, with changes in each environment affecting the other environments and behaviours. These complex sets of interactions need robust techniques in order for them to be accurately modelled. Therefore, attempts should be made to utilise nonlinear dynamical systems modelling (i.e., Edelstein-Keshet, 1988; Epstein, 1997).

Another explanation of the lack of a significant relationship between the perceived environmental variables and physical activity may be that some individuals are not accurately perceiving the environment. According to Agostinelli & Miller (1994) individual perceptions are created to minimize any negative and maximize any positive effects of a health behaviour. In their study, the authors examined alcohol use and drinking and driving, reporting that heavy drinkers were more likely to perceive a lower risk of the negative consequences of their drinking (e.g., accidental injury and getting into trouble). This notion may be applied in the physical activity domain whereby an individual who is inactive may underestimate the physical environment which would decrease the interactive effect between the environment and physical activity.

The only significant environmental finding from the second block of the hierarchical regression is that the perceived importance of the school physical environment was related to physical activity ($\beta = .14$, $p<.01$). This finding is interesting in that it demonstrates the important role a school setting might play in youth physical activity levels. This positive relationship between the perceived importance of the school physical environment and physical activity may be explained by the notion of value.

According to value-expectancy theories (i.e., Health Belief Model, Social Learning Theory) if value is attached by an individual to an event or object, the behaviour related with that event or object is more likely to be undertaken. With the amount of time and learning that takes place in the education system, schools have the opportunity to shape these values. If attempts to increase involvement in school life were made, then the school would play a larger role in the experience of the adolescent, thereby leading students to perceive the school as being important. Therefore, schools must be

encouraged to further expand upon both physically and non-physically active extracurricular activities to play an important role of shaping experiences of adolescents. This research reinforces the importance of focusing spending on education in order to invest in the future health and well-being of youth and continued spending on school physical environments related to physical activity.

The hierarchical regression also revealed that self-efficacy, sex, peer network and family network were all moderately associated to physical activity. This is congruent with findings from review studies on physical activity in youth (Sallis et al., 2000; Taylor & Sallis, 1997; Pate et al., 1997). The variables of age and teacher relationship were not found to be significantly related to physical activity. With respect to age, the non-significant finding may be a result of the sample's small variability (i.e., only four years). Explaining the non-significant finding for physical education teacher relationship is not as clear. One possible explanation is that youth interact with the teacher in only one (i.e., school) of the four environmental contexts while the remainder of the variables examined can be theoretically related to all four of the environmental contexts (i.e., home environment, neighbourhood environment, convenient facilities and school environment). The magnitude of effect for each variable except physical education teacher relationship is potentially increased through interactions in the multiple environmental contexts. Future research should be completed to determine if the physical education teacher relationship construct should be included when examining the school environment separately from the other contexts.

The four physical environment and four perceived importance of the physical environment measures were collapsed into global scores respectively. These two global

environmental constructs were moderately correlated ($r=.43$, $p<.001$). This result could be interpreted as meaning that only a moderate number of the physical environment measures were deemed as valuable for achieving physical activity. Therefore, the measurement tool may need to be strengthened whereby more highly valued environments are added and ones without value are not included in the questionnaire.

There were a number of limitations in this study which need to be acknowledged. First, the self-reported physical activity measure used was an approximation of actual physical activity levels. Even though our behaviour outcome was measured by energy expenditure there are inherent validity limitations with self-report measures (e.g., reliance on the individuals to accurately recall the participation levels and to be truthful in their reports). Future investigations may include more sensitive measures of physical activity (i.e., direct observation with a subsample) in order to provide increased validity. The second limitation deals with the sampling method used in the study. This study surveyed a convenient sample of Alberta rural schools and the generalizability of the results should cautiously be interpreted. A third limitation was that the study was cross-sectional in design. Therefore causation of the significant findings cannot be inferred. Longitudinal studies examining the role of multiple interacting environments should be conducted (i.e., testing of models similar to *Figure 2*). Additionally, randomised controlled trials with actual manipulations of the physical environment over multiple time periods would be helpful in determining the relationships between physical activity and the physical environment. Finally, further research regarding the use of environmental variables that are perceived important over those not perceived as important should be completed to

further distinguish the associations between the physical environment and physical activity.

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Table 1 Pearson Correlations Among Variables and Descriptive Statistics (N=610)

	2	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*Mean (SD)*
1	-.08*	.35**	.31**	.23**	.08*	.16**	.22**	.16**	.16**	.12**	.20**	.15**	.27**	1371(920)
2		.01	-.13**	-.09*	.06	-.06	-.12**	.02	-.04	.07*	-.11**	-.07	-.17**	2.58(1.11)
3			.21**	.11**	.17**	.10**	.13**	.15**	.12**	.11**	.19**	.13**	.21**	2.30(0.47)
4				.26**	.10**	.09*	.14**	.09*	.12**	.12**	.14**	.09*	.15**	2.55(0.71)
5					-.02	.16**	.09*	.03	-.02	.07*	.06	.08*	.11**	2.33(1.11)
6						.08*	.20**	.19**	.21**	.22**	.25**	.37**	.35**	3.22(1.27)
7							.45**	.17**	.26**	.27**	.35**	.17**	.31**	7.43(2.71)
8								.20**	.62**	.26**	.73**	.23**	.57**	2.56(0.84)
9									.35**	.40**	.23**	.25**	.19**	11.4(2.74)
10										.23**	.68**	.20**	.53**	2.87(1.00)
11											.34**	.23**	.24**	10.1(5.11)
12												.29**	.63**	2.53(1.00)
13													.44**	5.70(1.76)
14														3.06(1.03)

* $p < 0.05$ level (2-tailed) ** $p < 0.01$ level (2-tailed)

1. Energy expenditure
2. Grade
3. Self-efficacy
4. Peer Network
5. Family network
6. Teacher Relationship
8. Home environment score
9. Perceived importance home environment score
10. Neighbourhood environment score
11. Perceived importance neighbourhood environment score
12. Convenient facilities score
13. Perceived importance convenient facilities score
14. School environment score
15. Perceived importance school environment score

Table 2 Mutiple regression of the perceived physical environment scores on energy expenditure and perceived importance of the physical environment scores on energy expenditure (N = 610)

	R^2	*Beta 1*
Perceived Physical Environments	.05	
• Home Environment		.15*
• Neighbourhood Environment		.13*
• Convenient Facilities		.04
• School Environment		.11*
Perceived Importance of the Physical Environments	.08	
• Perceived Importance of the Home Environment		-.00
• Perceived Importance of the Neighbourhood Environment		.10
• Perceived Importance of the Convenient Facilities		.00
• Perceived Importance of the School Environment		.22*

* $p < .01$ Degrees of freedom are (4, 605) for the two equations.

Table 3 Hierarchical regression of the perceived physical environment, perceived importance of the physical environment and controlling factor scores on energy expenditure (N=610)

	R^2	R^2 Change	F Change	*Beta 1*	*Beta 2*
Block 1	.22	.22	28.62*		
• Self- efficacy				.30*	-
• Sex				-.15*	-
• Grade				-.05	-
• Teacher Relationship				.00	-
• Peer Network				.18*	-
• Family Network				.15*	-
Block 2	.26	.04	3.951*		
• Self- efficacy					.27*
• Sex					-.16*
• Grade					-.02
• Teacher Relationship					-.07
• Peer Network					.16*
• Family Network					.13*
• Home Environment					.02
• Perceived Importance of the Home Environment					.09
• Neighbourhood Environment					.05
• Perceived Importance of the Neighbourhood Environment					.01
• Convenient Facilities					.00
• Perceived Importance of the Convenient Facilities					-.04
• School Environment					.01
• Perceived Importance of the School Environment					.14*

* $p < .01$

Note: Beta 1 and Beta 2 are standardised regression coefficients for the linear equations represented by blocks one and two respectively. Degrees of freedom for the equation one are (6, 603) and for equation two are (14, 595).

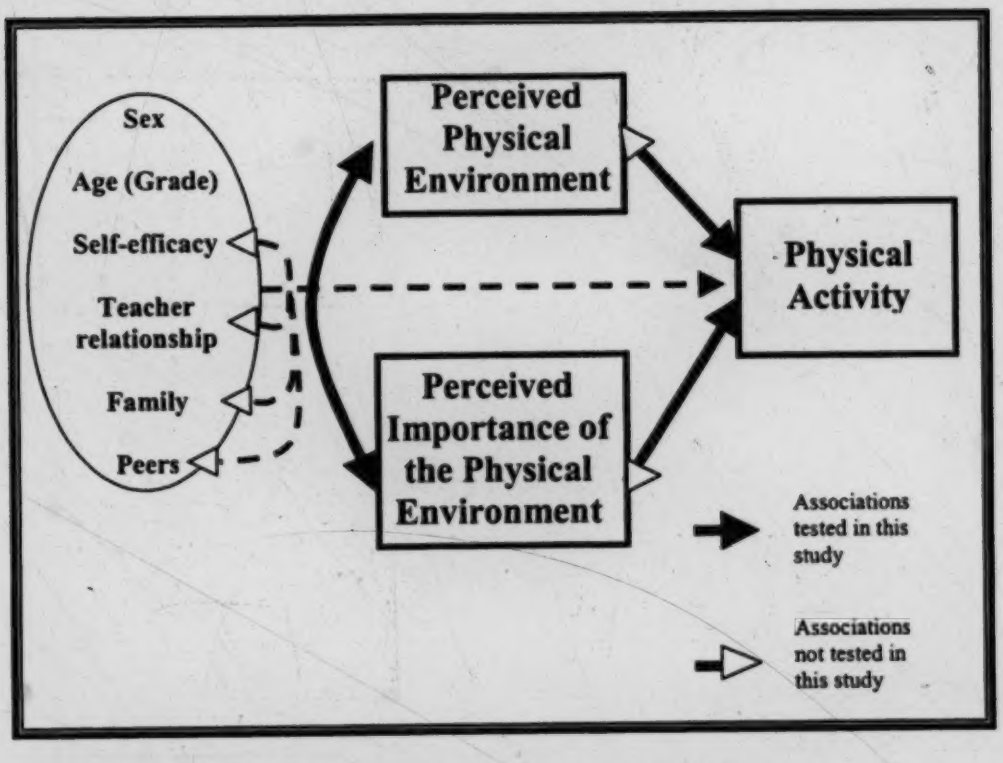

Figure 1 – The Physical Environment & Physical Activity Model

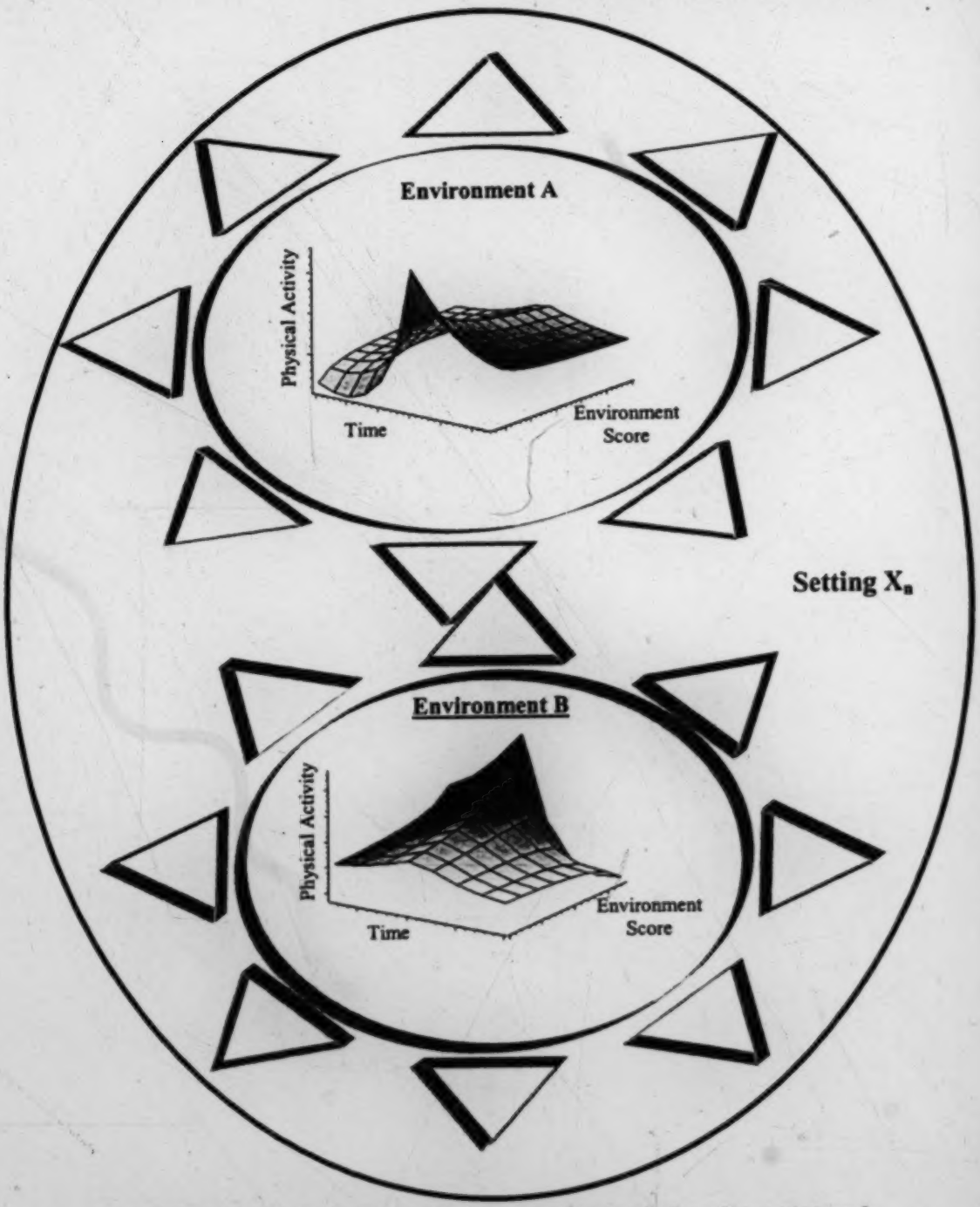

Figure 2 - A theoretical relationship between the physical environments and physical activity over varying time periods.

Note: Environments A and B represent two of many possible environments and setting X_n represents one of the many possible settings in which the environments exist. (n = setting 1, setting 2..., setting n)

CHAPTER 4 – CONCLUSIONS

This chapter presents the main conclusions from the two study aims followed by the study limitations, future directions for research, and practice and policy recommendations.

4.1 Main Conclusions

The first aim of this study was to determine the relationship between objective and perceived measures of the physical environment related to physical activity within a school setting. Two main research questions were posed to elucidate the findings. The first question addressed the accuracy with which students perceived the school physical environment conducive to physical activity. The results of the study point towards a small mean difference score (0.37) between the perceived and objective physical school environment. In relative terms, the perceived and objective measures of the physical environment are very comparable when considering the entire population. Therefore, depending on the resources and purpose of each study, either measure can be used in future studies to assess the physical environment related to physical activity.

The second question asked what the profile differences would be for individuals who perceived greater opportunities, fewer opportunities or the same opportunities in the physical environment as shown by the objective measure. Discriminant function analysis revealed that individuals who were predicted to be in the *perceive greater* group were discriminated from those in the *perceive fewer* or *perceive same* group by more positive teacher relationships (.91) and a greater level of physical activity (.42). As well, those subjects who were predicted to be in the perceive same group were discriminated from

the other two groups by peer network (.63), self-efficacy (.41) and physical activity (-.37). The examination of sex differences revealed a stronger association of family network and self-efficacy with the discriminant function for boys than for girls.

The second aim of this study was to examine the relationships between perceived physical environments related to physical activity, the perceived importance of the physical environments related to physical activity and physical activity. Four research questions were posed to specifically address this aim.

First, the relationship between the perceived physical environment and physical activity was to be examined. This was accomplished multiple regression analysis with four environmental contexts (i.e., home environment, neighbourhood environment, convenient facilities, school environment). The results demonstrated small significant associations between three of the perceived physical environment variables (i.e., home, neighbourhood and school) and physical activity.

The second research question examined the relationship between the perceived importance of the physical environment and physical activity behaviour. The multiple regression revealed that only the perceived importance of the school environment demonstrated a significant association with physical activity.

The third research question investigated the relationship between the physical environment and perceived importance of the physical environment. Zero-order correlations between the perceived physical environment scores and the perceived importance of the physical environment scores, for each environmental context, were low to moderate (i.e., r=.23 to .45).

To determine the relationship between the physical environment and the perceived importance of the physical environment over all four environmental contexts combined, global scores were constructed. A correlation of these two global scores demonstrated a Pearson r of 0.43 ($p<.001$), thus it can be concluded that a moderate relationship exists between the perceived physical environment and the perceived importance of the physical environment.

The fourth question utilized a hierarchical regression analysis to examine the combined relationship between the perceived physical environment and the perceived importance of the physical environment with physical activity. These findings were first controlled for sex, age, self-efficacy, family network, peer network, physical education teacher relationship. Only the perceived importance of the school environment was found to be significantly associated with physical activity.

The results of the two aims lead to the conclusion that perceptions of the physical environments are similar to the objectively measured physical environments but that there are limited associations of these environmental constructs with physical activity. *Chapter 2* and *Chapter 3* discussed possible interpretations of these conclusions including the specificity of the measurement tools and the possibility of various mechanisms through which physical activity may be associated to environment constructs. In a synthesis of both of the aims' results, one interesting issue arises. Specifically, the physical education teacher relationship was not significantly associated with physical activity (Aim 2). However, the same construct was highly significant when discriminating between subjects who perceive the physical environment as better than the objective assessment (Aim 1). Therefore, the inter-relationship between the physical

education teacher and the perceived physical environment variables is a plausible mechanism through which the physical environment is associated with physical activity. Thus, if the physical environment was manipulated, possible effects might be apparent in the physical education teacher relationship. Further, significant associations between physical activity and the physical environment might then result.

4.2 Limitations

There were a number of limitations in this study which need to be acknowledged. First, the self-reported physical activity measure was an approximation of actual physical activity levels. As with all self-report measures, reliance must be on accurate recall of participation levels and truthfulness in reporting. Even though the calculations were based on the energy expenditure estimation equation from the Canada Fitness Survey (Fitness & Amateur Sport, 1983; Weller & Corey, 1998), future investigations may include more sensitive measures (i.e., direct observation with a subsample) in order to provide increased validity of activity levels.

Second, the questionnaire took approximately 45 minutes to complete, which might have been a limitation for some students. An additional limitation regarding the questionnaire was the significant amount of missing data that could not be interpreted. In future a shorter questionnaire could be administered in order increase the number completed instruments.

Third, data from the environment questionnaire was inputted manually. While random checks and searches for outliers were conducted to minimise errors, future

instrumentation should be converted to a format that can be scanned by a computer. This would reduce potential errors in the data.

A fourth limitation, also involves the instrumentation. The environment questionnaire was based on the tool developed by Sallis et al (1997) which was used in a study examining a population of college students in the US. In the present study this measure was employed for high school aged youth in rural Alberta, Canada, and the assumption was made that this questionnaire was valid and reliable for this population. However, a pilot study with 30 Alberta high school students was completed to address this limitation.

The fifth limitation deals with the design of the study. The sample was chosen based upon the multi-step consent protocol set by the university and school districts. Superintendents from each school district were initially approached and, once the superintendents provided permission, the principals of the schools were contacted. Only four principals replied with an affirmative answer, therefore these particular schools were the convenient sample of the study's catchment area.

The sixth limitation is another measurement issue. The social and psychological questionnaire items were not the most rigorous measurement tools that could have been utilized. This was due to the complex and length of the questionnaire. Longer, but possibly better measures of such items as peer and family influences (rather than simply peer and family network) and self-efficacy would strengthen the results.

Finally, due to the complex, time consuming, and expensive nature of longitudinal research, this study employed a cross-sectional in design and causation of the study findings cannot be implied.

4.3 Future directions for research

The results demonstrate the need for further theoretical conceptualization and testing of the role of the physical environments in relation to physical activity. This is necessary due to the limited relationships in this study between the physical environment and physical activity. Given the theoretically proposed large impact that this interaction should have, longitudinal work is desired in order to determine causation between these factors. Such findings could prove invaluable for theorists, researchers, policy makers and health practitioners. These longitudinal studies would also be helpful in testing the theory supporting ecological approaches. For example, physical environments exist over various levels (i.e., organizations, communities, societies, supranations; Richard et al., 1996) and the interactions between and among these levels may be related to changes in physical activity.

Further refinement and standardization of the measures must be completed to accurately capture the interactions between the constructs of the PEPA Model. Additionally, the elements within the perceived physical environment construct must be determined (i.e., equipment or space or both). As well, the necessity of assessing and intervening on all elements of the physical environments, or if only those elements perceived as important, must be explored.

Another important direction for future research would be to assess the changes in activity level directly from changes in physical environments. For example, if new equipment was brought into a school, or if a swimming pool was built in the neighbourhood environment, would the activity levels of the youth change? As well, the use of more variable environments would allow for stronger comparisons to be made.

The use of more methodologically rigorous approaches (i.e., randomized controlled trials), where the actual physical environment related to physical activity is manipulated, would enable strong assessment of the impact of environmental change on physical activity.

4.4 Recommendations for practice and policy

While the results from these studies do not demonstrate strong associations between the physical environments of the home, neighbourhood or school with physical activity in youth, the physical environments should not be ignored. As the perceived importance of the school environment was demonstrated to be significantly related to physical activity, policy makers, teachers and principals should ensure that the school setting is conducive to curricular and extracurricular involvement. This is crucial since more involvement in the school setting could potentially generate a larger perception of importance, which in turn, may positively influence physical activity levels.

Additionally, the results of the study found that the overall mean level of physical activity was greater than the current recommended levels (Freedson & Melanson, 1996). Since each of the four schools had a similar score on the objective measure, and this level of environment was adequate to ensure the recommended minimum level of physical activity, schools should therefore, examine their own physical environments objectively and compare results to the findings in this study. The creation of a minimum physical environment standard to ensure the recommended level of physical activity to receive health benefits is important to all policy makers and health practitioners who examine how to disperse limited resources.

The findings from the second aim point towards the neighbourhood environment as the best perceived physical environment; the relative mean score (see results section in *Chapter 3*) for the neighbourhood environment was higher than all three of the other environment contexts. However, the neighbourhood environment was not associated with physical activity. Therefore, it appears as though resources currently being funneled towards creating positive environments in the community are working (i.e., the environments are good) but their influence on the physical activity behaviour of youth may be minimal. Given that the perceived importance of the school environment was the only significant construct associated with physical activity, continued support of the school environment may have the greatest effects on physical activity levels of youth. An important caveat to this recommendation is that while the good community environments may not be related to increases in physical activity with youth, increases with adults have not been tested in this study. Since adults do not attend school the neighbourhood environments should not necessarily be ignored.

Overall, as identified by previous studies (i.e., McKenzie, Marshall, Sallis, & Conway, 2000; Sallis & McKenzie, 1991), the school is a crucial intervention context when attempting to ensure positive health and well-being for youth. Every school should assess the physical environment as well as the physical activity of the students.

4.5 References

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APPENDIX I – REVIEW OF THE LITERATURE

I.1 Overview of the Chapter

Chapter One introduced the two frameworks to be utilitsed in this thesis and provided some general background regarding these models. This chapter supplies a more in-depth examination of the literature and theory for the models and the basis for the study. Specifically, this chapter will present the theory behind the conceptual models and literature supporting the constructs and the interactions of the constructs within the two models.

I.2 Introduction

Physical inactivity has been shown to be a physical and psychological health risk factor. Cardiovascular disease, certain types of cancer, diabetes, osteoporosis, and a decrease in the effects of many life distresses are major health issues that can be ameliorated by moderate to vigorous physical activity (Blair, Brill & Barlow, 1994; Greenberg, 1996). Studies have also demonstrated that positive physical activity experiences in childhood can improve intrapersonal and interpersonal factors such as self-concept and self-esteem, social acceptance, and even romantic appeal (Malina, 1994). However, a recent study showed that only 33% of Canadian adolescents are considered active enough for optimal health benefits (Canadian Fitness & Lifestyle Research Institute, 1998). Since physical activity is so important to health and well-being, it is imperative to examine how to promote physical activity participation.

I.3 The Conceptual Models

Marcus and Forsyth (1999) describe three streams of interventions that are currently being used to increase physical activity behaviour. Downstream interventions include cognitive-behavioural and clinical exercise interventions. Midstream interventions include training physicians to do physical activity counselling. Upstream interventions include athletic facility memberships and changing the environment to encourage activity. Of these three, the upstream interventions are the most theoretically and empirically embryonic but have potential to make a difference in increasing physical activity behaviour (Marcus & Forsyth, 1999).

A key component of upstream interventions is the environment. The term *environment* can include both the social environment (i.e., relationships with themselves and others) and the physical environment. Sallis, Johnson, Calfas et al. (1997) argue that research on the association between physical environments and physical activity has been neglected. However, it is important to strive to understand how physical environments relate to physical activity because of the potential capacity of these environmental factors to change exercise behaviour in large populations.

In order to complete rigorous, scientific research on the physical environment, it is important to define a framework in which to work. Presently, there is limited evidence supporting a single approach (or set of approaches) to study the relationship between physical activity and the physical environment. Therefore, extrapolations from other theories and evidence should be used to provide direction. Synthesising information from ecological and social-cognitive models has helped to conceptualize the Objective

and Perceived Physical Environments Related to Physical Activity Schema (OPPERTPA) and the Physical Environment & Physical Activity Model (PEPA).

I.3.1 The Theoretical Basis

The basis for the OPPERTPA schema (*Figure I.1*) and PEPA Models (*Figure I.2*) reflect three major theoretical approaches to physical activity. In the following sections these models and frameworks (i.e., ecological frameworks, Social Learning Theory, and the Health Belief Model) will be defined. This will be followed by literature supporting the inclusion of each construct in the OPPERTPA and PEPA frameworks.

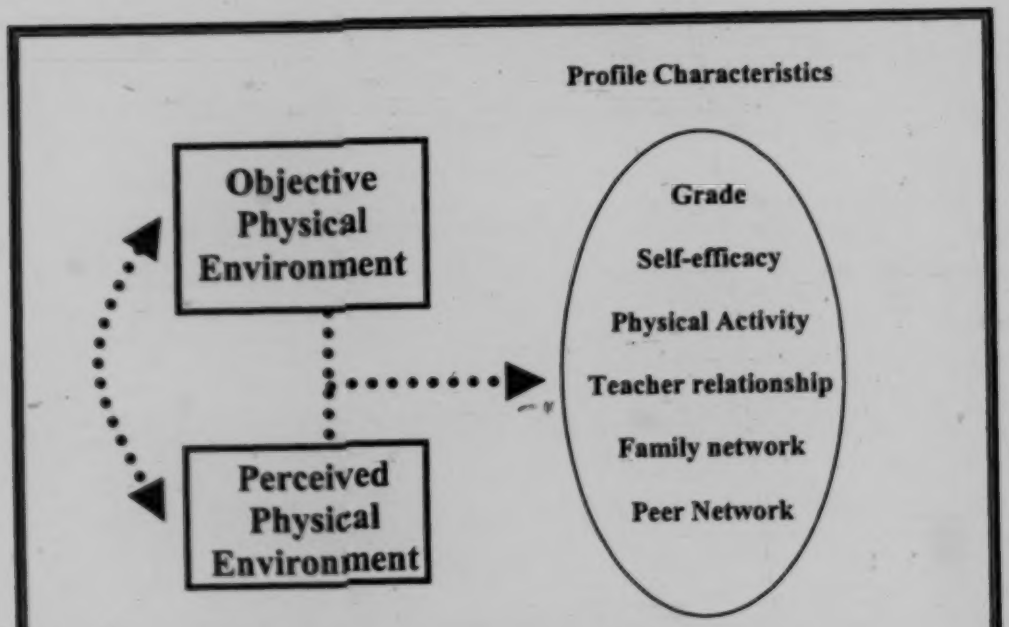

Figure I.1 – The Objective and Perceived Physical Environments Related to Physical Activity Schema: Study Aim 1

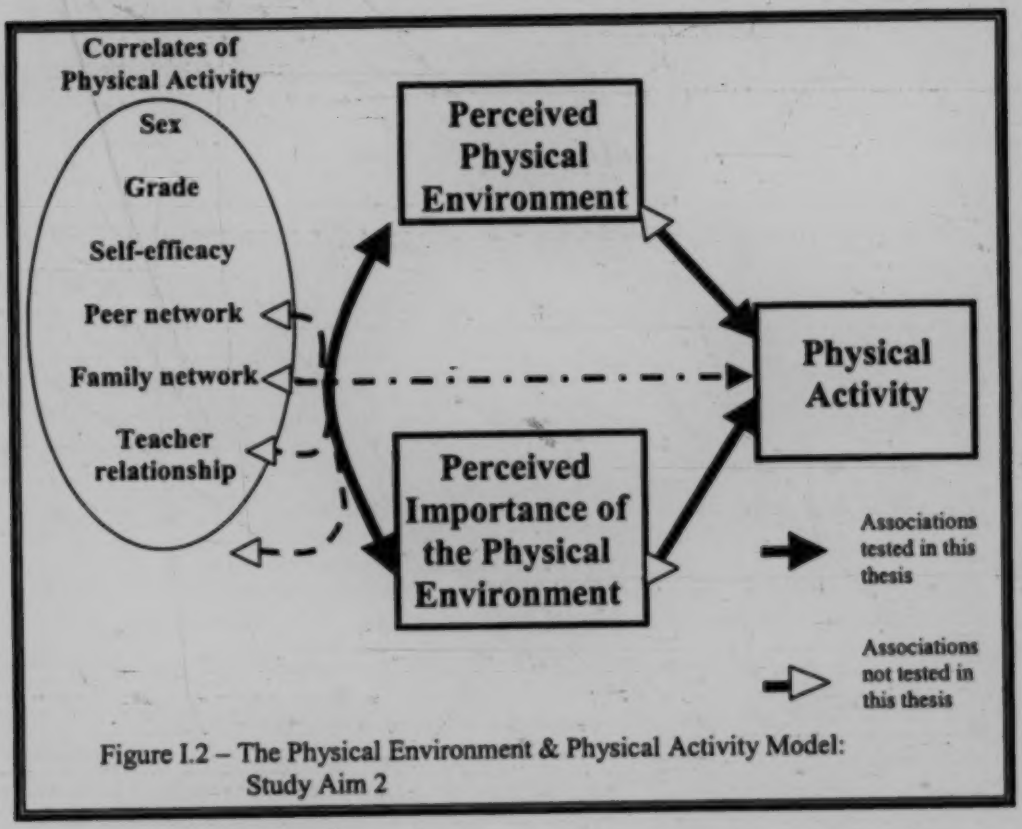

Figure I.2 – The Physical Environment & Physical Activity Model: Study Aim 2

I.3.2 Ecological Frameworks

Ecology is defined as "the study of the interactions of organisms with their physical environment and with each other" (Curtis & Barnes, 1989). Basically, those who study ecology examine the interactions, and the results of these interactions, between organisms and their living and nonliving environments (Curtis & Barnes, 1989). Concepts in ecology have been of interest to humans since the early stages of evolution of the species. However, modern ecology only began to be formed as a science when researchers started to closely examine relationships between living populations and their environments (Curtis & Barnes, 1989).

The new science of ecology was primarily geared towards plant and animal populations, while humans were seen as being separate entities (Catton, 1994). This was changed in the 1940s when ecologists realised that humans are part of a global ecology and have effects on the environments as well as being affected by those same environments. Catton (1994) further explores this concept by arguing that human ecology cannot be studied separately from other forms of ecology because of the interactions between human society and the societies of other organisms (e.g., the building of human cities encroaching on the natural habitats of other plants and animals). This association between many species (including humans) and many environments (living and non-living), create an *ecosystem*.

The challenge facing human ecology is in finding out how an ecosystem functions. Bennett (1996) argues that we must adopt a view of "disciplinary eclecticism". For example, we must examine all interactions within frameworks from many disciplines including, but not limited to, biology, anthropology, sociology, and psychology. Only through shared information between disciplines can we truly understand human ecology.

A general ecological model (Evans & Evans, 1987) contains five basic components (*Figure I.3*). The pivotal dimension of the model is the *setting* in which a behaviour takes place. This setting could be a home, a school, a place of work, a recreational setting, or any other that a person has an opportunity to interact with his or her environment. A key concept with many ecological models is the distinction that must be made between the *setting* and the *environment*. Settings, also called *levels* (McLeroy Bibeau, Steckler & Glanz, 1988), are the structures in which environments and

individuals exist. For example, a setting of a classroom is made up of the biophysical, physical and psychosocial environments. This distinction is important to understand because when targeting behaviours to change, the setting must also be modifiable. In other words, considering the setting and the environment as identical constructs would mean that the setting might be ignored when attempts to change behaviour were desired.

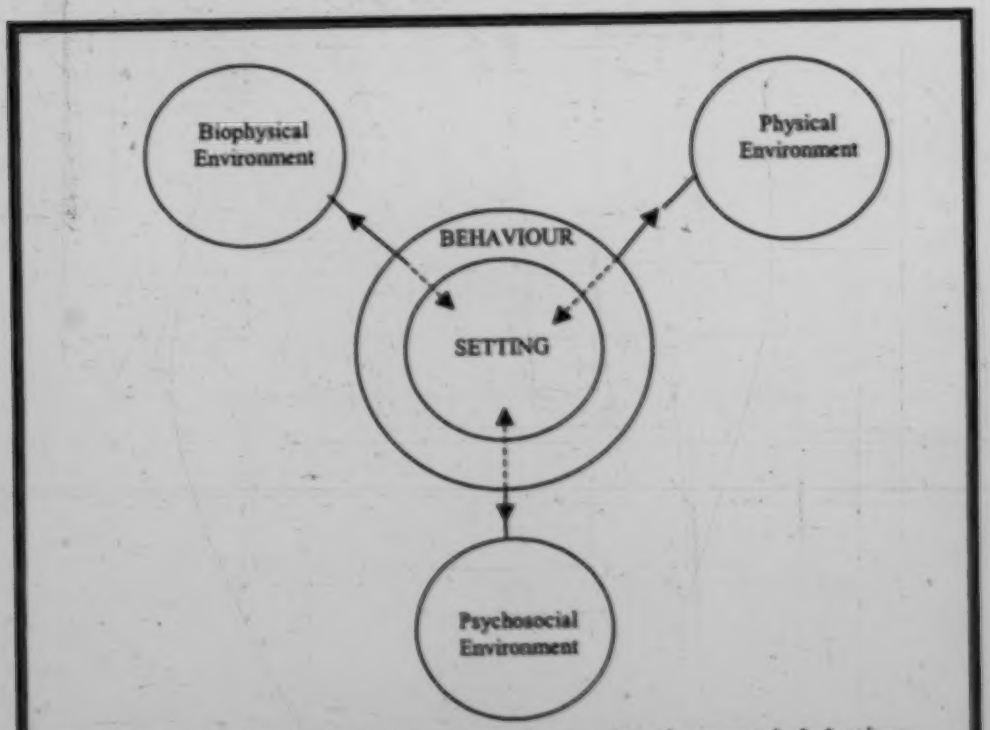

Figure I.3 – The interaction between behaviour and environment in behaviour settings. (Evans & Evans, 1987)

The Evans & Evans (1987) ecological model includes three environmental subdomains: biophysical, physical, and psychosocial. The biophysical environment includes individual factors that may affect behaviour such as dealing with an illness, being on medication, having allergies, or even genetic influences. The physical

environment includes such variables as space, technology and air quality. The psychosocial environment includes dimensions of culture, peer network, family network, and social cognitive components like locus of control and self-efficacy.

It is crucial to note that these environments are specific to each behaviour and setting. What may influence behaviour in a certain manner in one setting can vary in another setting or on another behaviour. For example, Edmundson Parcel, Feldman, et al., (1996) note that an intervention targeting psychosocial environments with respect to diet and physical activity behaviours produced significant results with only certain age groups of children. This demonstrates how similar psychosocial environments (i.e. the targeted intervention components) can have different impacts in different settings (i.e. the classrooms of older versus younger children).

I.3.3 Ecological Frameworks and Health Promotion

In the health promotion field there is a movement towards ecological approaches stemming from the Ottawa Charter for Health Promotion and the Epp Framework for Health promotion (Green et al., 1996). Ecological frameworks attempt to account for interactions between social, economic, and environmental factors, over various levels and through many sectors, all of which affect the health of a population (Green et al., 1996). Two influential ecological approaches to health promotion include the McLeroy, Bibeau, Steckler & Glanz model (McLeroy et al., 1988) and an adapted *Precede-Proceed Model* (Richard et al., 1996).

The McLeroy et al. model comprises the ideas surrounding the existence of interactions between multiple levels in health promotion interventions. These five levels

are: 1) intrapersonal factors (i.e., knowledge, attitudes and skills); 2) interpersonal processes and primary groups (i.e., formal and informal social network and social support systems); 3) institutional factors (i.e., social institutions with organisational structures and formal or informal rules and regulations); 4) community factors (i.e., relationships between organisations, institutions, and informal networks within defined boundaries); and 5) public policy (i.e., municipal, provincial, federal, and international laws and policies). According to McLeroy and colleagues, interventions targeting within and between these levels will lead to change of health of individuals and populations.

The Richard et al. (1996) model actually provides a structure for producing interventions. According to this approach, interventions can target similar levels as in the McLeroy et al. model. The targets proposed by Richard et al. (1996) are: individuals, interpersonal relationships between individuals, organisations in which the individuals belong, communities or community coalitions with which the individuals identify, and political players that are responsible to the individuals. Additionally, these targets exist within a hierarchy of social systems starting with *groups*, followed by *organisations*, *communities*, *societies*, and *supranational systems*. Higher order and lower order systems can affect every other system in the hierarchical schema.

I.3.4 Ecological Frameworks and Physical Activity Promotion in Youth

To date, ecological approaches for physical activity in the adult population have used existing models (i.e., McLeroy et al., 1988) with the addition of the physical environment component (Sallis & Owen, 1997). However, the belief that adult models can be simply transformed for a younger population is counterintuitive to one of the

principles of ecological models: each model must be specific to population as well as the behaviour (McLeroy et al., 1988). Indeed, psychological and motivational factors of physical activity affect youth differently from adults (Welk, 1999). Therefore, it follows that if an ecological approach is to be employed, specific ecological models must be produced to study physical activity behaviour in youth. Welk (1999) has recently developed the Youth Physical Activity Promotion Model (YPAPM) specifically for school (elementary, junior and senior high school) aged youth.

In order to develop the YPAPM, Welk (1999) turned to the Preceed-Proceed planning model (Green & Kreuter, 1991). The Preceed-Proceed Model states that, prior to any interaction, determinants of a behaviour must be considered. Next, factors that "predispose, enable, or reinforce" the behaviour must be determined and weighted according to "importance and potential for change" (Welk, 1999). The final step is to determine the available resources and possible barriers. Results from pre-existing studies (i.e., Sallis, Simons-Morton et al., 1992; Taylor & Sallis, 1997) in each of these areas (which determinants; which predisposing, enabling and reinforcing factors; and which resources and barriers) were used to create the various components of the YPAPM.

The above considerations are apparent in the YPAPM, as seen in *Figure I.4*. The determinants of physical activity are seen throughout the various steps in the model, each classified according to how it interacts with physical activity behaviour. For example, *self-efficacy* is grouped as a predisposing factor, while family network is placed under reinforcing factors. The YPAPM suggests that an individual's demographic factors may influence the predisposing, enabling and reinforcing factors which, in turn, influence physical activity behaviour of youth. Additionally, bi-directional arrows represent

feedback loops between constructs. For example, as physical activity increases the enabling factor of fitness will also improve which in turn, increases physical activity.

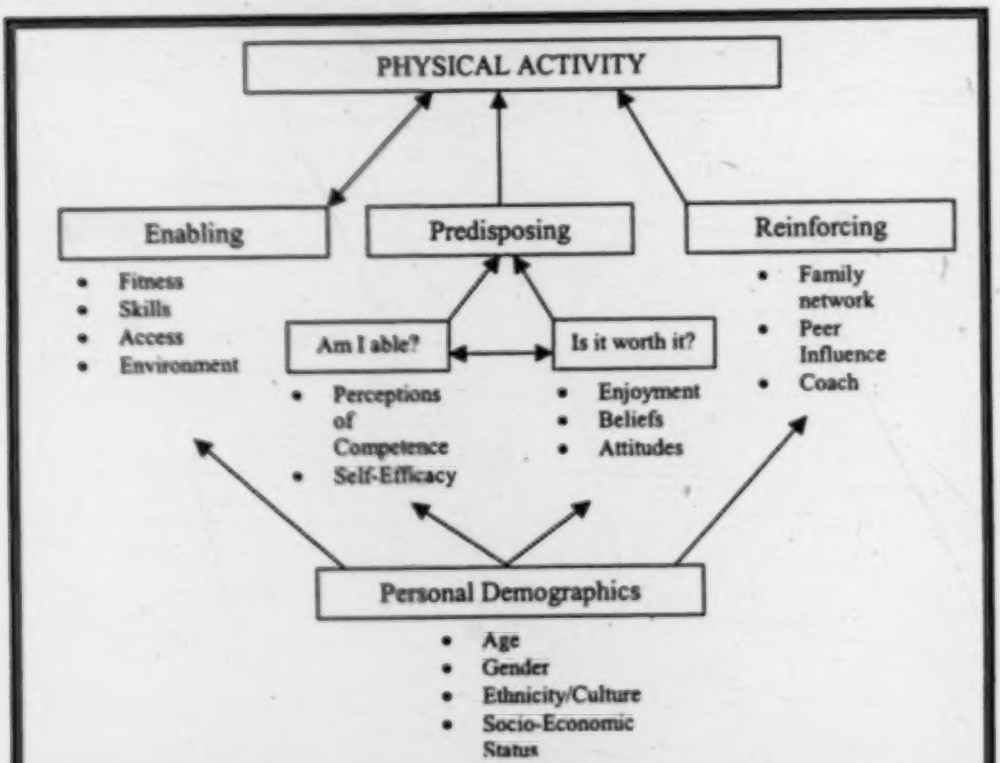

Figure I.4 – A conceptual diagram of the Youth Physical Activity Promotion Model (Welk, 1999)

The YPAPM is ecological as it follows all five of the ecological principles laid out by Sallis & Owen (1997). The first principle is that there are multiple dimensions of influence on behaviours. Welk (1999) adheres to the first principle by showing that there are various enabling, reinforcing, predisposing and personal demographic factors that influence behaviour. The second principle regarding the interactions of influences across dimensions is addressed with the arrows representing interactions between the various

factors. The third principle, multiple levels of environmental influences, is articulated through the use of various levels (as termed by McLeroy et al., 1988). The *intrapersonal* constructs include such items as fitness, skills, self-efficacy, and age. The *interpersonal* constructs include the items of family, peer and coach influence. The *institutional*, *community* and *public policy* constructs are seen under such items as access, and environment. These items represent the larger group levels because the schools, community and governments are the groups responsible for such things as creating programs and permitting access to facilities. The fourth principle is that environments directly influence behaviours. Since all of the enabling, predisposing and reinforcing factors represent the environments, and these directly influence physical activity behaviour, the fourth principle is upheld. Finally, the fifth principle is that ecological models must be behaviour-specific. This principle is inherent to the YPAPM because it is specifically geared towards physical activity behaviour in youth.

The YPAPM model is very highly supported by the existing literature (e.g., Garcia, Broda, Frenn et al., 1995; Ferguson, Yesalis, Pomrehn & Kirkpatrick, 1989; Stucky-Ropp & DiLorenzo, 1993; Zakarian, Hovell, Hofstetter, 1994) and, due to its structure, provides a link between theory and practice. However, missing from the YPAPM is an in-depth examination of the role of the physical environments related to physical activity.

1.3.5 Challenges of Operationalizing Ecological Frameworks

Ecological approaches to predict behaviour are very complex and demanding. First of all, to determine causality the research must be longitudinal in design. This is

because interactions between an individual and its environment might change over time, a fact that stems from the underlying basis for all ecological approaches (i.e., the interactions between individual and environment are dynamic in nature).

Second, many environments may be working in conjunction with each other regardless of a researcher's or program planner's design (Richard et al., 1996). Therefore each environment, or groups of environments, might need to be targeted in varying amounts of magnitude (e.g., intensity, duration) and specific order of sequencing. Each environment must also be observed for change after each intervention or program due to the potential effects that environments may have on each other.

Third, the process of creating actual change may be limited by external sources. Often, attempts to make changes in an environment are blocked by governments or other groups, especially if the change negatively affects the group's agenda. An example of this was the attempt by the municipal government in Toronto to ban smoking in public restaurants and bars. Restaurant and bar owners believed that this would reduce their profits, so they did not comply with the law. Smokers felt that this law would infringe upon their rights to smoke (Randell & Randell, 1997). Since the process was not accepted by the individuals and groups, the change was not successful.

Fourth, the changes might have unanticipated effects on another environment, on the individual, or even reciprocal consequences back onto the originally targeted environment. From biology, once again, we gain a term called co-evolution; a term congruent with the Social Learning Theory's principle of reciprocal determinism. Basically this term states that as one environment or organism changes, all of the other environments and organisms adapt to those changes. This then leads to further adaptation

of the original organism or environment (Curtis & Barnes, 1989). Therefore, we must consider that any given physical activity promotion program might be able to grow into a stable program. However, each program must be adaptable to all changes in the environments, even those caused by the simple existence of the program itself.

Due to these challenges, a full ecological approach is not always the appropriate choice for programs or interventions. Thus other theories, seen as part of the intra- and interpersonal levels of an ecological approach, may be used to assist in operationalizing the ecological framework. In the case of the PEPA Model (*Figure 2.2*), the Health Belief Model and Social Learning Theory's reciprocal determinism were drawn upon to help in this manner.

1.3.6 The Health Belief Model

The Health Belief Model (HBM) was originally designed to explain why people do not participate in programs that could improve their health (Strecher & Rosenstock, 1997). The basic principle of the HBM is that of *value expectancy* which can be defined as when a person values something they will attempt to achieve what they value. In the case of health, a person subjectively decides how great the risk is that he or she will contract an illness, and how serious that illness will be to his or her life. A determination of the benefits of taking action along with a cost-benefit analysis of overcoming barriers to action is considered. Further internal analysis of one's perceived ability to perform an action as well as the existence of visual or other prompts to act are then examined before all of these decisions are weighed against each other and a behavioural outcome is the result (Rosenstock, 1990). The HBM therefore has the following key concepts:

perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and *self-efficacy*.

Additional support for the PEPA Model can be gathered from components of the Health Belief Model. The key constructs from HBM that pertain to the development of the PEPA Model are *perceived barriers and benefits*, and *cues to action*. Perceived barriers are defined as the negative perceptions that block action (Strecher & Rosenstock, 1997). Some examples include perceptions that a recommended action is expensive, painful or too time consuming. In the PEPA Model, the physical environment is viewed as a barrier to physical activity. For example, the lack of appropriate and enough equipment and space could prevent an individual from participating in physical activity. Alternatively, the physical environment can be seen as facilitating as adequate and valued equipment and space may permit an individual to be physically active.

Cues to action are defined as the preliminary events which cause an individual to begin to think, or remind an individual, about taking some sort of action (Strecher & Rosenstock, 1997). An example of such a cue could be when an individual sees a baseball diamond in a school yard and thinks about organising a game of baseball. In the PEPA Model, the perceived importance of the physical environment and the actual physical environment combine to create cues to action. If an individual perceives an environment as important and then has access to that environment, he or she will be more likely to act. For example, if a student perceives a swimming pool as important and the community has a swimming pool located on the path the student walks to school each day, we predict that the student will be more likely to want to swim.

1.3.7 Social Learning Theory's Reciprocal Determinism

Further theoretical support for the OPPERTPA and PEPA Models is found in Social Cognitive Theory, specifically the principle of *reciprocal determinism*. Reciprocal determinism is defined similar to the definition of ecology, in that there exists a "dynamic interaction between the person, the behaviour, and the environment in which the behaviour is performed" (Baranowski et al., 1997). This dynamic relationship of variables is apparent in the literature.

One study (Sallis et al., 1992) completed a longitudinal analysis of a number of Social Learning Theory variables and physical activity in a sample of 1,739 adults. Some of the variables included self-efficacy, family support, normative beliefs, social modelling, and the home and neighbourhood environments. The results demonstrated a 7.7% increase in variance explained when the constructs were measured using variables that would change over time. This is important because it supports the concept of *reciprocal determinism* in that behaviours are based on dynamic relationships and therefore the measures should also be dynamic in nature. For example, if a method of being physically active is popular at one time during research but at a later time that same activity is no longer of interest to people, using participation in that activity as an indicator of physical activity level may be incorrect. The PEPA Model utilises this concept in that there is interplay between the constructs. In other words, the PEPA Model would predict that changes in environments or controlling factors would affect physical activity just as the reciprocal is true.

I.4 Environment Constructs Related to Physical Activity

The OPPERTPA and PEPA Models together comprise three key environment constructs related to physical activity. First is the objective physical environment construct, which is measured by researcher observation. Second is the perceived physical environment construct, which represents individual perceptions of how the physical environment provides opportunities for engaging in physical activity. The third environmental construct is the perceived importance of the physical environment related to physical activity. These three constructs will now be explored in the existing literature

I.4.1 The Objective Physical Environment Related to Physical Activity

With respect to the objective environment, two studies with youth and one study surveying adults have examined relations between the observed environment and physical activity (Bloch & Laursen, 1996; Johns & Ha, 1999; Brownson et al., 2000). At first, the results of the study by Bloch & Laursen (1996) do not appear to support the notion that the physical environment plays an important role in physical activity behaviour but interpretations of the results by the authors demonstrate a mechanism through which the physical environment is crucial. In this study, a total of 280 children and adults were observed in a school yard with a newly built sport playground. Additionally, interviews with 58 children were conducted. Results showed that most of the children preferred to play in the school yard (71 children) rather than use the playground (34 children). Confounded by the results the authors examined reasons for the school yard preference. One of their possible explanations was that the various environments (intrapersonal, social, and physical) work together to create behaviour. For

example, a certain stigma may exist towards those children who play on the playground and preferred games might be better suited to the larger, more open space allowed by the school yard. The combination of these two elements (one social and one physical) might guide the behaviour (i.e., larger participation rates in the school yard). Despite the lower rates of playground use, theoretical support exists for the building of such a physical environment related to physical activity. According to Sallis et al. (1998) programs to increase physical activity are more successful if the physical environment is already in place. However, ideally the groups involved would be consulted as to what physical environmental needs were lacking before any intervention – environmental or educational – could be started.

A second empirical study, completed with elementary school children in Hong Kong (Johns & Ha, 1999), also found only a limited influence of the physical environment on physical activity behaviour. In this study, 40 children were observed both in the home and in school settings over a total of 10 observation periods. Physical activity was assessed as the percentage of time spent lying, sitting, standing, being active or being very active. In the school setting the majority of the observed time was spent standing and in the home most of the time was spent sitting. The major physical environmental differences were that the home spaces were very small (e.g., in high-rise buildings) while the school setting allowed play in parks and playgrounds. In the small, adult-controlled home setting, the level of active play was quite low with only 10.5% of the time spent being active or very active. In the school setting, during free playtime, the activity level was high for the first few minutes but quickly reduced to a much lower level with a total of 31.4% of the time spent being active or very active. Since, even in

the larger play settings the physical activity levels were low, it appeared that the children were being motivated by factors outside of the physical environment. However, this interpretation might not be completely true, as this study assumed that the existing physical environment was appropriate, desired and sufficient to instil a desire in the children to become physically active. Therefore, research on the physical environments related to physical activity must also consider the perceived importance of those physical environment components to the individual with respect to his or her physical activity desires.

A very recent study with adults examined changes in physical activity (specifically walking behaviour) in two rural Missouri communities which underwent an increase in the building of paved walking trails (Brownson et al., 2000). This study interviewed 1269 randomly chosen adults from 15 control and the two treatment communities in Missouri. In total, 36.5% of respondents reported access to walking trails, 14% reported using trails and approximately 8% of the those with access reported an increase in their walking. Unfortunately, no comparison between original walking rates before the construction of the trails and the walking rates after the building of the trails in the two experimental communities was reported. However, the authors do propose that the data suggest a benefit from building walking trails, especially for persons who are more sedentary or are in lower socioeconomic status groups. Therefore it appears as though physical environments can be useful in promoting physical activity.

1.4.2 The Perceived Physical Environments Related to Physical Activity

As is implicit in theory (i.e., Ecological frameworks, HBM, Reciprocal Determinism), the environment plays a crucial role in physical activity behaviour. The environment can be further classified as the *social environment* and the *physical environment*. McLeroy, Bibeau, Steckler & Glanz (1988) define the social environment as the support systems with which an individual may connect (e.g., other people, institutions or within a community). The physical environment is represented by the objects that the individuals have interaction with (e.g., buildings, parks, roads and equipment). Sallis, Johnson, Calfas, et al. (1997) state that physical environmental factors are the least studied variables when examining physical activity and, since physical environments have the capacity to influence behaviour over a large population level, research in this area is imperative. Unfortunately, researchers have been slow to address this issue. To date, only one published study exists that has examined perceived physical environments related to physical activity (Sallis et al., 1997). No study has been published that examines high school aged youth in particular.

Sallis, Johnson et al., (1997) surveyed 110 college students soliciting 'yes' or 'no' responses to statements about the presence of physical environmental variables that could promote physical activity (i.e., equipment & facilities related to physical activity) in the home environment, neighbourhood environment and at convenient facilities. The three physical activity measures of minutes of walking per week, frequency of strength exercises, and frequency of vigorous exercise were employed to assess activity levels. After key demographic variables (i.e., socioeconomic status, age, sex) were controlled for, only a small amount of variance (7%) was explained by the perceived environmental

variables and was only apparent when predicting strength exercises. No added variance was accounted by the environmental variables when walking or vigorous exercise were modelled as outcomes. The authors explained the minimal association between the physical environment and physical activity by theorising that there might be a difference between the observed and self-reported physical environment. Their explanation is supported by previous findings reported by Sallis, Hovell, Hofstetter et al. (1992) who found that objectively measured environments were significantly related to physical activity behaviour while perceived self-reported measures were not. The Sallis, Johnson et al. (1997) study was limited in scope as it only surveyed university students from one geographic area and did not examine the data for potential subgroup differences which might prove important in terms of environmental perceptions.

1.4.3 Perceived versus Objective Physical Environments

Both perceived and objective physical environments may be related to physical activity. However, it is useful to know the magnitude of the relationship between the perceived and objective measures. Since most studies use perceived measures, as they are less expensive and easier to assess via a self-report questionnaire, a high correlation between subjective and objective measures would mean that little difference would arise in employing either the perceived or objective measure. On the other hand, low or no correlation between perceived and objective scores would mean that using perceived rather than the objective measure would result in incorrect analysis and, thus, faulty conclusions. Indeed, there is a call in the current physical activity literature (Sallis et al., 1992; Sallis & Owen, 1997; Sallis et al., 2000) to investigate the relationship between the

perceived and objective assessments as this has not, to date, been empirically researched in the physical activity domain.

Research can be synthesised from other subject areas to help formulate hypotheses regarding the relationship between perceived and objective measures. Two studies were found that examined perceived and objective measures; the first in an environment context and the second pertaining to health.

The first study researched the perceived and objectively measured driving distance of 892 subjects, as determined by the distance from the driver's nose to the steering wheel (Segui-Gomez et al., 1999). Two groups were created: those people who sit less than or equal to 12 inches from the steering wheel, and those people who sit greater than 12 inches from the steering wheel. Approximately 74% of the subjects classified themselves correctly, most of which (73%) were sitting greater than 12 inches from the steering wheel. Out of the 26% who reported inaccurately, a vast majority (97%) reported that they sat more than 12 inches away when they really sat less than or equal to 12 inches. The conclusions from this study demonstrate that people who sit more than 12 inches from the steering wheel when driving a car are more able to correctly predict this distance than are those who sit closer to the wheel. Those who incorrectly predict their driving distance are more likely to report a larger length thereby underestimating the danger in which they are placed.

A second study (Niknian et al., 1989) also found that those who were inaccurate in their perception of risk were more likely to underestimate than overestimate. In this case approximately 4,171 subjects were asked to rank their perceived risk of heart attack and stroke. Only 43% were correct in their risk assessment, while 40% underestimated

the risk and 17% overestimated the risk. Both studies found that a majority of individuals accurately perceived their risk and a greater likelihood of individuals who are at risk to underestimate the risk and perceive themselves as safe. However, the magnitude of the difference in those who are correct in their risk assessment (i.e., 73% correct in the driving distance study and 43% in the risk of heart attack study) demonstrates that each context should be examined separately. Additionally, in the physical activity domain it has been reported that activity levels are also often over-reported; thus in agreement with the found underestimation of risk in the other two studies. Further, Rothman and colleagues (1996) report a high variability when examining perceived risk between different health domains. This adds further support to assessing each health behaviour separately.

I.4.4 Perceived Importance of the Physical Environments Related to Physical Activity

One of the major questions asked in philosophy is "What is real?". This question has led behaviour scientists down a path of perception research. Specifically, the constructs in theoretical frameworks such as the HBM deal with the individual perception of the 'real' world rather than a researcher ascribed value for truth. In general, studies have examined the perceived importance of physical exercise (i.e., Adamson & Wade, 1986; Laffrey & Isenberg, 1983) or the perceived importance of group membership on a sports team (i.e., Ebbeck & Stuart, 1993). After an extensive literature review, it does not appear as though any empirical literature exists which has examined the notion that the perceived importance of the physical environment is associated with physical activity

behaviour. However, there is support through extrapolations from other empirical studies that can provide indirect evidence for this relationship.

Laffrey & Isenberg (1983) completed a study that examined locus of control, the value of physical activity and the perceived importance of physical activity. This study examined 70 women in the United States and used a self-report questionnaire to collect the data. The key result of this research found that perceived importance of exercise accounted for 21% of the variance for physical activity during leisure time, with locus of control and the value of physical activity only explaining an additional 1% of the variance. While this study examined adult women, and the findings may be limited in their generalizability, it appears that if an individual perceives something as important, that perception may significantly affect the corresponding behaviour.

While no direct evidence could be found linking perceived importance of the physical environment to physical activity, the evidence provided by the conclusions of the three studies reviewed above has demonstrated a strong association between perceived importance and behaviour constructs. The results from these studies do indirectly reinforce the inclusion of the construct measuring the perceived importance of the physical environment related to physical activity in the PEPA Model.

I.5 Physical Activity Measurement

Acquiring a valid and reliable physical activity measure is challenging. Blair (1984) discusses assessing physical activity and raised a number of important issues. First, the type of exercise to be measured must be determined. A researcher must decide what combination of light, moderate and vigorous physical activity will be measured and

whether the measurement will include leisure as well as occupational physical activity. Additionally, decisions regarding direct (i.e., maximal oxygen uptake testing) versus indirect (i.e., questionnaires) assessment and how often these measures will be obtained, must be determined. While direct methods might produce more valid results, the costs are relatively high and the methods can be time consuming. As well, utilising direct methods outside of the clinical laboratory setting can often prove difficult. On the other hand, the indirect methods are more cost effective and can be completed in shorter amounts of time with larger populations. However, indirect methods are less accurate and have limitations regarding the ability of an individual to recall past physical activity events. Since testing the multiple correlates of physical activity is complex and directly measuring physical activity level can be expensive over large samples, self-report questionnaires are usually utilised in epidemiological studies (Plowman & Smith, 1997; Blair, 1984).

A further issue that must be considered when investigating an adolescent sample is the appropriateness of the instrument being employed. Freedson & Melanson (1996) state that the use of self-report physical activity measures is appropriate with youth and each instrument should be designed to match the objectives of the study. The authors reviewed a number of interviewer-administered and self-administered questionnaires and concluded that older age groups of subjects tend to demonstrate increases in reliability. The results with respect to validity were more indeterminant as the validity coefficients were small (in general: $r<.60$) between the questionnaire items and the validity criteria. However, the conclusion that results demonstrate self-report measures to be invalid would be false because the dimensions of physical activity captured by the self-reported

might have simply been different from the validity criteria measures. For example, criterion measures might have been assessing oxygen uptake or heart rates while the self-report instruments were examining actual activity type, duration, frequency and intensity.

A calculation using frequency of activity, duration of activity, and intensity of activity is normally used to determine a continuous measure of self-reported physical activity (i.e., Fitness and Amateur Sport, 1983; Sallis, Buono & Freedson, 1991; Sallis, Buono, Roby, et al, 1990; Wallace, McKenzie & Nader, 1985). This calculation creates an estimation of caloric (or energy) expenditure often reported in kilocalories per unit of time (Weller & Corey, 1998; Plowman & Smith, 1997) and is further explored in the method sections of this thesis (see *Chapter 2*, *Chapter 3*, and *Appendix II*).

I.6 Correlates of Physical Activity

Physical activity behaviour of youth cannot be directly determined from only one variable or category of variable, but is influenced by biological factors, psychological factors, sociocultural factors, and environmental factors (Rosenstock, 1990). Current review articles (Pate et al., 1997; Sallis et al., 2000; Taylor & Sallis, 1997) demonstrate a relationship between forty-eight biological, psychological, behavioural and sociocultural factors with physical activity in adolescents which have been tested in various studies under many different combinations of factors and theories. Given that there is so many possible influencing factors (and combinations of factors), measuring the correlates of physical activity in adolescent samples is a large and complex task. However, in agreement with multiple review articles (Sallis et al., 2000; Rosenstock, 1990; Taylor & Sallis, 1997) a number of correlates of physical activity have been included as profile

characteristics in the OPPERTPA Schema and as correlates of physical activity in the PEPA Model. These variables are: sex, age, self-efficacy, peer network, family network and physical education teacher relationship. The justification of including these variables in the models is provided below.

I.6.1 Sex & Age

Since males and females experience the world differently and differences within an individual occur over the life span, it is likely that sex and age are associated with physical activity. For example, Manios, Kafatos, & Codrington (1999) compared fitness levels and physical activity behaviour among young children. They found that there was no significant difference between boys' and girls' fitness scores even though there were differences in physical activity preferences. From this the authors concluded that, even at young ages, males and females choose to participate in different activities and at different levels, regardless of their physical fitness. Additional support for this conclusion appears in the current statistics regarding physical activity in youth, which state that 15% of adolescent females are less active than are adolescent males (Canadian Fitness & Lifestyle Research Institute, 1998).

Rudman (1989) found that the amount and type of physical activity changes as a person gets older. Increased age was demonstrated to be correlated with physical activity in a number of review studies (i.e., Dishman & Buckworth, 1996; Sallis et al., 2000; Sallis et al., 1992). Evidence is also available to show that physical activity participation can vary even within the small age-range of adolescence (Bungum & Vincent, 1997).

Allison & Adlaf (1997) also studied age and sex differences in physical activity among a large sample of Ontario teenagers. Their study found a large decline in activity level was seen between the ages of 15 and 16. Allison & Adlaf (1997) explained this finding as the result of changes in social pressures and the ability of youth not to choose physical education as a course in school after age 15. Sex was also reported to have a profound effect in this study, as females were twice as likely as males to report being inactive.

I.6.2 Self-efficacy

Self-efficacy is defined as one's perception of their own capabilities (McAuley, 1994), which change as an individual succeeds or fails at accomplishing specific goals (Kavussanu & Roberts, 1996). Self-efficacy is the strongest correlated psychological construct with physical activity in adolescents (Sallis, Simons-Morton, et al., 1992)

A study completed by Allison, Dwyer & Makin (1999) examined a population of 1,041 grade 9 and 11 students in Toronto. Three physical activity contexts were examined (i.e., *physical education classes*, *other school physical activity*, and *outside of school physical activity*) and two measures of self-efficacy were identified (i.e., *self-efficacy despite external barriers* and *self-efficacy despite internal barriers*). This study found that self-efficacy despite external barriers was a significant predictor of participation in physical activity outside of physical education class (i.e., $\beta_{\text{other school}} = .54$ and $\beta_{\text{outside school}} = .41$) and that self-efficacy despite internal barriers was not significantly related to physical activity in or out of the school setting. The findings of this study supports existing theory and empirical evidence that self-efficacy may directly influence

physical activity participation. However, there is also an important possible link to the physical environment; the external barriers may be more important than internal barriers with respect to the relationship between self-efficacy and physical activity.

A body of literature exists in the area of the social influences on the physical activity of school aged youth (i.e., Godin & Shephard, 1986; McLellan et al., 1999; Moon et al., 1999). The following studies highlight the key social influences on physical activity in youth. A consistent conclusion made in these studies demonstrates that family, peers, and teachers have a significant influence on student physical activity participation.

I.6.3 Family Network

Recent trends in research on the education system have begun to examine the importance of sources outside of the school which may influence the behaviour of the youth during school (Moon et al., 1999). One of these external influences is the family, especially the parents.

One of the supporting studies (Wold & Anderssen, 1992) highlights the strong association between the participation of children in sport and parental sport participation. This study examined students aged 11, 13 and 15 years old from European countries and Israel. In total 39,086 subjects completed a questionnaire, which included demographic variables, physical activity levels, lifestyle variables (i.e., smoking and drinking habits) and psychosocial aspects of health. The results from this study demonstrated that, except for Scotland, a same sex relationship exists between parent and child and physical activity level. Specifically, a father's behaviour is more influential over boys while a

mother's behaviour is more influential over girls. As well, Wold and Anderssen (1992) state that children are much more likely to participate in sport if their parents and siblings take part.

Another study (Aarnio et al., 1997) examined the influence of three generations on each other's physical activity in a family setting. Both intra- and intergenerational correlations were examined. The authors found that adolescents experience a larger influence from sibling interactions than from parent or grandparent interactions. Additionally, same sex parent-child pairs were more likely to demonstrate similar physical activity patterns than opposite sex pairs. However, relationships between grandparents and grandchildren physical activity levels was very limited, therefore the activity level of grandparents may not be an important factor to examine extensively. Given that parents, and to a greater extent siblings, may exert influence on physical activity, constructs examining family network on the physical activity of youth should measure the influence of the entire family instead of only the influence of the parents. Further, the trend of an increased effect with a decrease in the age gap between the youth and their family members may demonstrate a relationship between peers and physical activity behaviour.

I.6.4 Peer Network

Wold and Anderssen (1992) also examined the influence of a best friend on the individual physical activity level of the child. Their analysis found that the activity level of the best friend was the strongest predictor of the activity level of children ($\beta_{boy/best\ friend}$ = .20, $\beta_{girl/best\ friend}$ = .23). Three possible mechanisms were provided for this finding.

First, children might influence each other to be active. Second, children may engage in sport because their best friend is involved in that particular sport. Third, children establish friendships with peers with whom they are participating in sport. Any of these three mechanisms may be in effect at any one time. As well, it is possible that the mechanism(s) will change as children develop through childhood, adolescence and early adulthood. For example, middle school aged children (6 – 12 years old) describe close friends as those who like the same activities (Newman & Newman, 1995). This changes by early adolescence (13 – 17 years old) as individuals begin to identify themselves with a peer group rather than individual friendships (Newman & Newman, 1995). Therefore, high school aged youth may be influenced by the physical activity of their peers as long as exercise behaviour allows them to identify positively within the existing social structure.

Supporting the findings of the influence of peer behaviour on individual behaviour, Gottlieb & Baker (1986) discuss the importance of increased peer support when attempting to increase physical activity levels in a study of 1,500 Texas college students. Additionally, this study supports the Wold and Anderssen (1992) finding that for males, peer influence ($\beta_{male\ friend} = .21$, $p<.001$) is actually a stronger predictor than the father's influence on physical activity ($\beta_{father} = .14$, $p>.05$). A similar result was found for females when peer influences were compared to the influence on physical activity by the father ($\beta_{male\ friend} = .17$; $\beta_{female\ friend} = .19$; $\beta_{father} = .15$; $p<.001$). The gender differences also show that male peers are significant correlates of both males and females, while female peers only seem to be associated with female activity behaviour. This is an important finding from an ecological viewpoint, as it reinforces the point that each

interaction between an individual and the environment (i.e., peer relationship) must be broken down into the specific components in order to achieve an accurate evaluation of the interaction.

I.6.5 Teacher Relationship

Intuitively, physical education teachers should be influential with respect to the physical activity of their students, especially with the amount of time that adolescents spend in school each week. Phillips, Carlisle, Hautala et al. (1985) investigated this relationship, examining teacher personality, teaching process, time on a task, and student outcomes. These researchers found that certain personality types, the ability of the physical education teacher to analyse students' needs and longer time on tasks, correlated highly with an increase in activity skills. From these data we can infer that a teacher does influence the physical activity behaviour on some level, but we cannot confidently conclude that teachers will influence the volume, intensity, duration or type of activity in adolescents.

In a related study by McLellan, Rissel, Donnelly et al. (1999) eight health behaviours were correlated with the students' perceptions of teacher support. The results demonstrated that students were more likely to increase their amount of exercise (i.e., more than one hour per week) if the physical education teachers were perceived as supportive. This result was adjusted for possible confounding factors such as grade, gender, average weekly pocket money and the social school environment measures.

I.7 Summary of the Review of the Literature

This chapter examined the theoretical bases and constructs of the OPPERTPA Schema and PEPA Model. A limited number of studies have been published examining the physical environment related to physical activity and less has been found relating the perceived importance physical environment to physical activity. Additionally, it appears that no research has investigated relationships between the perceived and objective physical environment as they predict physical activity. Key correlates of physical activity (i.e., sex, age, self-efficacy, family, peer and teacher relationship) have been demonstrated in the literature to be necessary to consider when researching the exercise behaviour of youth.

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APPENDIX II – METHODS

The purpose of this Appendix is to: 1) provide further details of the methods used in the two studies (Chapters 2 & 3); and, 2) provide details of data diagnostic procedures and data analysis. Information regarding the subjects, measurement tools employed and procedures is reported as a synthesis of the Methods sections from the previous two manuscripts.

II.1. Subjects & Response Rates

The subjects for this study were rural Alberta high school students in grades nine to twelve in four high schools. The total population of the four schools was 1595 students however, researcher access classes was limited by the school principals. Thus, a total of 1291 individuals were eligible, of which 914 completed the questionnaire, resulting in a 71% response rate (914/1291). However, due to missing data a final sample size of 851 cases were subjected to analysis in the first study and 610 cases were subjected to analysis in the second study. For Aim 1, approximately 59% of the sample were female, and there was a relatively even distribution among grades 9 through 12 was apparent (22% grade 9, 28% grade 10, 25% grade 11, 25% grade 12). A similar sample distribution was reported for Aim 2 with 62% being female, 21% in grade 9, 28% in grade 10, 26% in grade 11 and 25% in grade 12.

II.2. Measures

Two questionnaires and one audit tool were utilized to collect the data in this study. The first questionnaire was the *Student Physical Activity and Smoking Survey* (Health Behaviour Research Group, 1999), an eight page self-report survey. The second

measurement tool was the *Environments Related to Physical Activity Questionnaire*, which was specifically modified and designed for the present study. This questionnaire was based on the measure developed by Sallis, Johnson, Calfas et al. (1997). The *Environments Related to Physical Activity Questionnaire* was pilot tested with a sample of Alberta high school students. The audit tool (*The School Physical Activity, Physical Environment Scale*) was specifically designed to objectively score the physical environment of the schools.

II.2.1. Objective Physical Environment Measure

The objective school physical environment measure was based on a set of criteria regarding the planning, designing and operating of athletic facilities for high schools and universities (Spoor, Cox, & Brown, 1998) and by information from various facility planning guides (i.e., Farmer, Mulrooney & Ammon, 1996; Flynn, 1993). To ensure an accurate representation of the existing Alberta school facilities policy, the most recently published government source (Turik, 1971) was also consulted.

The objective audit tool was broken down into the seven domains of: gymnasiums, equipment, pool, fields, arenas, change rooms and showers, and accessibility. A scoring system was developed producing a score out of ten for each domain. These scores were summed and meaned to create a final school environment score out of ten. For the areas of gymnasiums, pool, fields, arenas and accessibility, 'Yes/No' responses were required. For the section of equipment, the number of each type of equipment was considered in the calculation; with a greater amount of equipment equaling a greater environment score. For the section of change room and showers a

rating system was developed based on classifications of odour, cleanliness, and space. This measure was expert tested with three physical educators in Alberta and changes were made based on these suggestions prior to the objective environmental assessment of the study proper.

II.2.2. Perceived Physical Environment Measure

The perceived physical environment constructs were assessed by slightly modified measures developed by Sallis, et al. (1997) which was comprised of three environmental subscales (the home, neighbourhood and convenient facilities). Items for each subscale employed 'Yes'(1) / 'No'(0) response options to statements regarding space (e.g., roads, sidewalks) and equipment (e.g., weights, shoes, tennis raquets) related to physical activity. The sum of the number of 'Yes' answers yielded scores for each environmental context. The home environment (15 items) was scored within the range of zero to 15, the convenient facilities (17 items) summed into a range of zero to 17 and the neighbourhood environment (12 items) produced scores within the range of one to 16. The neighbourhood environment was scored from a minimum value of one because the scale employed 11 'Yes/No' responses and an additional item regarding perceived neighbourhood safety. This question assessed the perceived safety of the neighbourhood (i.e.,"How safe do you feel walking in your neighbourhood during the day?") with five-point Likert-type scale (very unsafe=1; very safe=5)].

The Sallis et al. (1997) instrument was modified to include the school physical environment as a fourth context. The 12 perceived school environment items were set as visual analogue scales where subjects would respond to a statement by placing an 'X'

along a line rated zero (strongly disagree) to ten (strongly agree). Examples of the items included: "The gym space allows me to do all the activities I want."; "The sport or exercise equipment works well."; and "The athletic facilities at my school are easily accessible to me." The perceived school environment scores were summed and converted to a single score out of ten. A pilot test of this modified version of the Sallis et al. (1997) instrument was conducted with a sample of 30 high school students in the province of Alberta to ensure the modified instrument's relevancy Alberta school youth population.

Originally the perceived school physical environment measures were also "Yes/No" responses but this was changed as further sensitivity was deemed necessary in order to be able to compare the objective and perceived environments. Therefore, the perceived school environment questions were set as visual analogue scales where subjects would respond to a statement by placing an 'X' along a line rated zero (strongly disagree) to ten (strongly agree). Examples of the items included: "The gym space allows me to do all the activities I want."; "The sport or exercise equipment works well."; and "The athletic facilities at my school are easily accessible to me." The perceived school environment scores were summed and converted to a single score out of ten.

II.2.3. Perceived Importance of the Physical Environment Measure

The perceived importance of the physical environment measure had parallel items with the perceived physical environment measure. For each environment (home, neighbourhood, convenient facilities, and school) the question "How important is each item to you when deciding to be physically active?" was asked. This question was

changed from "How important is each item to you to be physically active?" after the pilot and expert testing was completed. Responses were completed in a five-point Likert-type manner (Not at all important=1; Very important=5). Scale means of these responses were calculated for the perceived importance of the physical environment scores for each of the four physical environmental contexts.

II.2.4. Physical Activity Measure

Due to the length of the survey instruments, a simple measure of physical activity was used as the dependent variable for this study. Students provided self-report answers to their number of exercise bouts, and the approximate duration of each of the bouts over the period of one week. A continuous score representing the energy expenditure of each subject for the moderate and hard physical activity intensities, outside of school hours was calculated. The calculation was based on the reported estimation of energy expenditure equation reported in the Canada Fitness Survey questionnaire (Fitness & Amateur Sport, 1983; Weller & Corey, 1998):

$$EE = (N \cdot D \cdot MET)_{moderate} + (N \cdot D \cdot MET)_{hard}$$

where: EE = energy expenditure in $kcal \cdot kg^{-1} \cdot week^{-1}$

N = number of days of activity in the past week

D = duration in minutes of that activity level

MET = mean metabolic equivalent value for that level of activity in $(kcal \cdot kg^{-1} \cdot minute^{-1})$

The energy expenditure was calculated for both the *moderate* and *hard* levels as collected in the questionnaire. The intensity levels were defined with examples. Hard physical activity was defined as: "exercise such as jogging, jazz dancing basketball and mountain biking, which increase your heart rate and make you breathe hard and sweat"; and moderate activity was defined as: "lower intensity activities such as walking or bicycling to school and recreational swimming". The frequency questions asked the subjects to report how many days in the past week they participated in activity of each intensity (e.g., 0 days, 7 days). The duration questions offered the subjects six categories of 10 minute intervals to choose from (e.g., 0-9 minutes; 10-19 minutes). The average score in each category was used to calculate the duration (e.g., 4.5 minutes, 14.5 minutes). The MET score used was the mean of the range for each intensity level of physical activity (i.e., $MET_{moderate}$ = 3.95; MET_{hard} = 5.95). These MET score ranges were developed from the *Seven-day Physical Activity Recall* (Blair, Haskell, Ho et al., 1985; Blair, 1984) and have been demonstrated as valid and reliable for eleventh grade children by Sallis, Buono, Roby et al. (1993). By summing the energy expenditure scores for hard and moderate physical activity each individual subject received a total estimated energy expenditure score used as the dependent measure.

II.2.5. Other Measures

Major demographic, cognitive and social factors often associated with physical activity in youth were also assessed. The demographic variables included sex (males=1; females=2) and age (grade 9=1; grade 12=4). The cognitive factor of physical activity self-efficacy was assessed as the mean of five items (e.g., "How sure are you that you can

get up early, even on weekends, to exercise?"; "How sure are you that you can exercise even though you are feeling sad or highly stressed?"). Each of five situations was responded to as 'I'm sure I can't' (1), 'Unsure' (2), or 'I'm sure I can' (3). The social variables were assessed by three, one-item measures. The peer and family networks were measured on four point scales (none=1, all=4) based on the response to the questions "How many of you closest friends participate in physical activity?" and "Not counting yourself, how many people in your home participate in physical activity?". Physical education teacher relationship was measured with a five point response option (not at all=1; very much=5) to the question "Since grade 8, how much have you liked your PE teacher?". A pilot study of 30 Alberta high school students was completed to help ensure validity of the measures.

II.3. Procedure

Each school was chosen through the appropriate protocols predetermined by university and school district procedures. After permission was received from the superintendents of the various school districts and the principals of the schools, a package including the questionnaires, parental/guardian consent forms, and teacher information sheets, were sent to each school. Schools were chosen based on size and permission from the principals to administer the questionnaire.

All students were asked to participate and any that opted-out had another, teacher-planned activity to complete while the questionnaire was being administered. Each student was provided with informed consent and a parental permission form, from the

principal of the school, and told that they may remove themselves from the study at any time without any consequences.

On a mutually agreed upon date chosen by the principal and the researchers, two observers distributed and collected the questionnaires. The classroom teachers supervised the completion of the questionnaires; however, the observers were available in the school to answer any questions that may have arisen. The questionnaire took approximately 45 minutes to complete.

Following the collection of all the completed questionnaires the two observers were led on a tour of the school facilities by either the Principal or a physical education teacher. During this tour the objective measurement tool was completed independently by each observer. Questions were asked of the tour guide by the observers in order to ensure that the entire objective instrument could be completed accurately. The resulting inter-rater correlation for the objective measurements was high (r=.89). For one school the tour was not completed on the original day (i.e., after the administration of the questionnaire) due to circumstances outside of the control of the school or the researcher. This day was rescheduled and as no changes or renovations to the physical environments related to physical activity were attempted by the school, this is not seen as major procedural limitation.

II.4. Data Screening

Multivariate analyses are generally considered statistically robust for social science research (Tabachnick & Fidell, 1989). However, in order to avoid statistical

errors, a number of data screening procedures were employed prior to the analyses. The following procedures were completed (see *Table II-1*).

Table II-1. Checklist for screening data (from Tabachnick & Fidell, 1989)

1. Inspect univariate descriptive statistics for accuracy of input
   a) Out-of-range values
   b) Plausible means and standard deviations
   c) Coefficient of variation
2. Evaluate amount and distribution of missing data: deal with problem
3. Identify and deal with nonnormal variables
   a) Check skewness and kurtosis
   b) Transform variables (if desirable)
   c) Check results of transformation
4. Identify and deal with outliers
   a) Univariate outliers
   b) Multivariate outliers
5. Check pairwise plots for nonlinearity and heteroscedasticity
6. Evaluate variables for multicollinearity and singularity

Since the construction of the questionnaire allowed for only certain responses, all of the data appeared to be within the proper range. The means and standard deviations were reasonable and plausible, and none of the correlations appeared inflated. Therefore, no composite variables were constructed. However, many of the perceived importance variables were quite highly correlated. This was to be expected as the measurements of importance of one item could be related to another. For example the importance of strength training equipment in the home can be related to strength training equipment outside of the home.

The amount of missing data (see *Table II-2*) proved to be an interesting challenge and lead to a limitation in this study. The largest amount of missing data appeared in the perceived importance of the home, neighbourhood and convenient facilities sections. The ability to predict the missing scores from other data in the survey or inserting mean

scores were not plausible. Thus, any subject who failed to report at least two-thirds of an environmental context section (i.e., home, neighbourhood, school, convenient facilities) was deleted from the analysis. For subjects who reported at least two-thirds of a section, a mean for the scale score was estimated using the number of complete questions for that particular section.

Table II-2. Description of scoring system, valid data and missing data for all of the variables

Variable	Mean (SD)	Scoring Range	Valid Data	Missing Data
Perceived home environment	7.43(2.71)	Summation 0 → 15	912	2
Perceived importance of the home environment	2.56(0.84)	Mean Likert 1 → 5	716	198
Perceived neighbourhood environment	11.4(2.74)	Summation 0 → 16	914	0
Perceived importance of the neighbourhood environment	2.87(1.00)	Mean Likert 1 → 5	808	106
Perceived convenient facilities	10.1(5.11)	Summation 0 → 15	906	8
Perceived importance of the convenient facilities	2.53(1.00)	Mean Likert 1 → 5	788	126
Perceived school environment	5.70(1.76)	Mean Sum 0 → 10	888	26
Perceived importance of the school environment	3.06(1.03)	Mean Likert 1 → 5	887	27
Age	2.58(1.11)	Choice 1 → 5 (Grade 9 – 12)	913	1
Sex	1.61(0.49)	Choice 1 → 2 (Male vs Female)	913	1
Self-efficacy	2.30(0.47)	Mean Sum 1 → 3	896	18
Family Network	2.33(1.11)	Choice 1 → 4	891	23
Peer Network	2.55(0.71)	Choice 1 → 4	905	9
Teacher Relationship	3.22(1.27)	Likert 1 → 5	889	25
Energy Expenditure	1371(920)	Equation calculation	907	7
Objective School Environment	0.37(1.80)	Mean Sum 0 → 10	8	0

Skewness and kurtosis was minimal for practically every variable (see *Table II-3*). Transformation of the dependent variable (energy expenditure) was completed to create a more normal distribution however, the square-root of energy expenditure did appear to have a higher degree of normality. Further analysis was completed and no meaningful difference was found between using the transformed and untransformed variable. Therefore, the decision was made to use the untransformed version of energy expenditure for future analyses because it would be more difficult to interpret results utilising the transformed version.

Table II-3. Skewness & kurtosis of the variables and the reliability of the objective measure.

Variable	Skewness	Kurtosis
Perceived home environment	.28	.09
Perceived importance of the home environment	.45	.15
Perceived neighbourhood environment	- .54	.66
Perceived importance of the neighbourhood environment	.05	- .58
Perceived convenient facilities	- .39	-1.03
Perceived importance of the convenient facilities	.46	- .25
Perceived school environment	- .22	- .07
Perceived importance of the school environment	- .21	- .54
Grade	.10	-1.16
Sex	- .40	-1.84
Self-efficacy	- .66	.04
Family Network	.22	-1.28
Peer Network	.29	- .30
Teacher Relationship	- .24	- .94
Energy Expenditure	.63	- .26

	Inter-rater Correlation
Objective Physical Environment Measure	.89

The reliability of the objective physical environment measure was also calculated (see *Table II-2*). Two observers independently measured the objective physical environment at each of the four schools and a very high correlation (r=.89) was reported leading to the conclusion that the results of the objective physical environment measurements can be considered reliable.

A bivariate scatter plot (see *Figure II-1*) of the independent variables versus the dependent variable demonstrated acceptable levels of homoscedasticity. Therefore, no transformation of the variables seemed necessary. Additionally, the scatter plot of the residuals from the regression demonstrated linearity of the variables. As would be expeeted, the perceived importance of the physical environment constructs were all somewhat correlated with each other with Pearson r's ranging from .53 to .73 ($p<.01$). As most of these are below .70 (Tabachnik & Fidell, 1989) issues surrounding multicollinearity are not expected. For the correlation between the perceived importance of the home environment and convenient facilities, the large r (.73) might have weakened the analysis because of a reduction of the degrees of freedom for error. However, the perceived importance of the convenient facilities and the perceived importance of the home physical environment were included because they were determined to be two separate entities that necessitated separate scores.

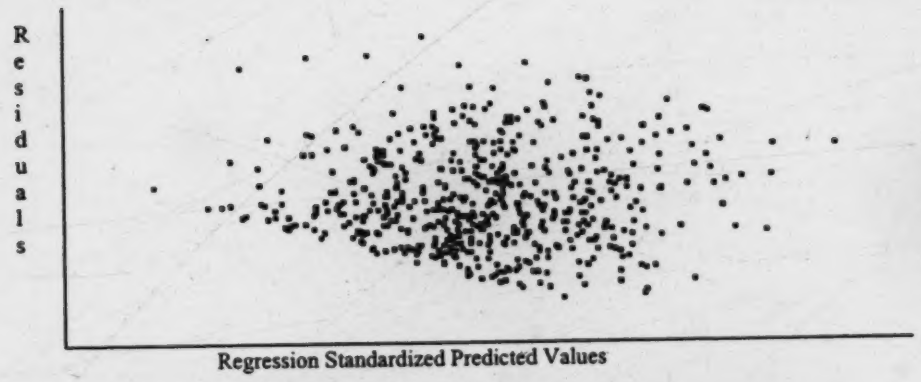

Figure II-1. Scatter plot of the residuals from the regression

II.5. Data Analysis

Aim 1

A direct discriminant analysis (see *Table II-4*) was completed in order to determine what characterized those subjects within a group that *perceived greater* opportunities than, *fewer* opportunities than or the *same* opportunities as the objective physical school environment related to physical activity actually afford. A *difference score* was calculated subtracting the perceived school physical environment score from the objective school physical environment score. Therefore, a negative score represented a higher perception of the perceived physical environment and a positive score represented a higher perception of the objective physical environment.

Table II-4. Checklist for discriminant analysis (from Tabachnick & Fidell, 1989)

1. Issues
   a) Unequal sample sizes and missing data
   b) Normality of sampling distribution
   c) Outliers
   d) Linearity
   e) Homogeneity of variance-covariance matrices
   f) Multicollinearity and singularity
2. Major analyses
   a) Significance of discriminant functions. If significant:
      1. Variance accounted for
      2. Plot(s) of discriminant functions
      3. Loading matrix
   b) Variables separating each group
3. Additional analyses
   a) Group means for high-loading variables
   b) Pooled within-group correlations among predictor variables
   c) Classification results
   d) Change in Rao's V (or stepdown F) plus univariate F for predictors

The discriminant analysis was run three times. First, the subjects were broken into groups using tertiles. One-third of the subjects were placed into the perceive greater group (those with the largest negative difference score), one-third into the perceive same group and one-third into the perceive fewer (those with the largest positive difference score). Second, the groups were created by using natural break-points as determined from the examination of a histogram (see *Figure 1 in Chapter 3*). The natural breaks revealed a better prediction equation than employing tertiles to select the membership of the three groups.

In an attempt to further discriminate between the three groups, the discriminant analysis was conducted a final time. The difference with this third analysis was the inclusion of physical activity as one of the independent variables. Since physical activity

did appear to be a strong discriminating factor of the first function, this final analysis was determined to be most complete and therefore was the one chosen to be reported.

Aim 2

To analyze the second aim, a hierarchical regression was completed (see *Table II-5*). A high power was expected since the ratio of cases to independent variables was almost 44:1, well above the minimum requirements for a hierarchical regression (Tabachnick & Fidell, 1989). The data screening techniques described above demonstrated that overall, the data were normal, linear and not highly correlated.

Table II-5. Checklist for hierarchical regression (from Tabachnick & Fidell, 1989)

1. Issues
   a) Ratio of cases to IV's
   b) Normality, lenearity, and homoscedasticity of residuals
   c) Outliers
   d) Multicollinearity and singularity
2. Major analyses
   a) Multiple R^2, F ratio
   b) Adjusted R^2, proportion of variance accounted for
   c) Squared semipartial correlations
   d) Significance of regression coefficients
   e) Incremental F
3. Additional analyses
   a) Unstandardized (B) weights, confidence limits
   b) Standardized (β) weights
   c) Prediction equation
   d) Post hoc significance of correlations
   e) Suppressor variables

The regression analysis was completed twice in order to ensure the most normal dependent variable was used. First, a non-transformed version energy expenditure was used as the dependent variable. The second analysis used a square-root transformation of

energy expenditure of the dependent variable. No meaningful difference was found in variance explained nor on the significant standardized beta coefficients between the two analyses. Thus, in order to simplify the explanation of the regression, the non-transformed dependent variable was chosen for reporting.

As well, two regressions were completed for the perceived physical environments and energy expenditure (*Table II-6*). First the regression was completed using the complete data set (N = 873) and then it was completed again after the parallel missing cases from the perceived importance of the physical environment constructs were removed (N = 657). Since no difference was found in the variance explained or the significant standardized beta coefficients the smaller sample size results (i.e. complete data) were reported.

Table II-6. Comparison of regression results for the perceived physical environment on physical activity scores using the complete data set and after removing those subjects who were missing on the perceived importance of the physical environment scores.

	$R^2_{all\ data}$	$R^2_{missing\ data}$	$Beta_{all\ data}$	$Beta_{missing\ data}$
Perceived Physical Environment	.055	.059		
• Home Environment			.128*	.121*
• Neighbourhood Environment			.083**	.108**
• Convenient Facilities			.014	.024
• School Environment			.128*	.110*

* p<.01 ** p<.05

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Appendix III – Questionnaires

The first questionnaire presented in this appendix is the Environments Related to Physical Activity Questionnaire. Due to the nature of the margin spacing necessary for thesis requirements, the questionnaire is not presented in the form in which it was administered. However, all of the items and examples of the questionnaire format are shown.

Environments Related to Physical Activity Questionnaire

Home Environment – Please indicate which items you have in your home, yard, or apartment complex and how important each item is to you when you are making the decision to be physically active.

a) Stationary aerobic equipment
b) Bicycle
c) Dog to walk
d) Running shoes
e) Swimming pool
f) Weight lifting equipment (e.g., free weights, Nautilus®, Universal®)
g) Toning devices (e.g., heavy hands, ankle weights, Dynabands®, Thighmaster®)
h) Aerobic workout videotapes or audiotapes
i) Step aerobics, slide aerobics
j) Skates (roller, in line, or ice)
k) Sports equipment (balls, racquets)
l) Canoe, bow boat, kayak
m) Skis (snow or water)
n) Skateboard
o) Snowboard

For each of the above items a "Yes/No" response was employed and the question "*How important is each item to you when deciding to be physically active?*" was answered on a five-point Likert-type scale.

YES	NO	*How important is each item to you when deciding to be physically active?* Not at all	A little	Moderately	Quite	Very
☐	☐	☐	☐	☐	☐	☐

Neighbourhood Environment – Please indicate which of the following apply to where you live (i.e., your neighbourhood) and how important each item is to you when you are making the decision to be physically active.

a) Sidewalks
b) Lack of road traffic
c) Hills
d) Street lights
e) Clean air
f) Dogs that are attended/fenced
g) Enjoyable Scenery
h) Frequently see people walking or exercising
i) Low crime
j) Paved roads
k) Wide road lanes

For each of the above items a "Yes/No" response was employed and the question "*How important is each item to you when deciding to be physically active?*" was answered on a five-point Likert-type scale.

YES	NO	*How important is each item to you when deciding to be physically active?* Not at all	A little	Moderately	Quite	Very
☐	☐	☐	☐	☐	☐	☐

Also included in the neighbourhood environment section was the following question.

How safe do you feel walking in your neighbourhood during the day?
(1 = very unsafe; 5 = very safe)

1	2	3	4	5
☐	☐	☐	☐	☐

Convenient Facilities – For each of these places where you can exercise, please indicate if it is on a frequently traveled route (e.g., to and from school) or within a 5-minute drive from your school or home and how important each item is to you when you are making the decision to be physically active.

a) Aerobic/dance studio
b) Basketball court
c) Beach or lake
d) Bike lanes or trails
e) Golf course
f) Health spa/Gym
g) Martial arts studio
h) Playing field (soccer, football, softball, etc.)
i) Public park
j) Public recreation centre
k) Racquetball/squash court
l) Running track
m) Skating Rink
n) Sporting goods store
o) Swimming pool
p) Walking/hiking trails
q) Tennis courts

For each of the above items a "Yes/No" response was employed and the question "*How important is each item to you when deciding to be physically active?*" was answered on a five-point Likert-type scale.

YES	NO	*How important is each item to you when deciding to be physically active?* Not at all	A little	Moderately	Quite	Very
☐	☐	☐	☐	☐	☐	☐

School Environment – Please mark an "x" on the line to indicate how strongly you agree with the statement regarding the school environment and how important each item is to you when you are making the decision to be physically active.

a) The gym space allows me to do all the activities I want.

b) The gym space is big enough.

c) The sport or exercise equipment works well.

d) There is enough sport or exercise equipment in my school.

e) The pool my school uses enables me to do all the aquatic activities I want.

f) There are enough fields at my school to allow me to practice or play my activity.

g) The are enough arenas at my school to allow me to practice or play my activity.

h) The changing areas are clean.

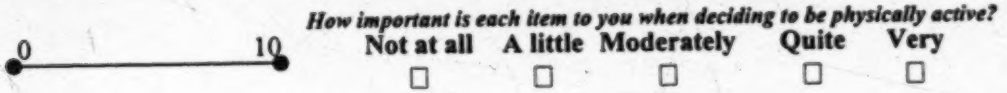
i) The changing areas are comfortable.

j) The shower areas are comfortable.

k) The athletic facilities at my school are easily accessible to me.

l) The athletic facilities at my school are safe.

For each of the above items a line labeled from zero to ten was provided to allow the subject space to respond using visual analogue style. An example was provided to show the subjects how to proper mark the line. As well, the question "*How important is each item to you when deciding to be physically active?*" was answered on a five-point Likert-type scale.



The final question was posed to collect data on the physical education teacher relationship.

Since grade 8 how much have you liked your PE teachers?

1	2	3	4	5
☐	☐	☐	☐	☐
Not at all	**A little bit**	**Moderately**	**Quite a bit**	**Very Much**

The objective physical environment audit tool was completed independently by two observers during a tour of each school. The scoring was calculated by the researcher after all of the audits had been completed.

The School Physical Activity, Physical Environment Scale

GYMNASIUMS

The "Gold Standard" gym is one that contains all of the following in perfect working order:

	YES	NO
• Full gym (six basketball keys)	.	.
• Additional gym	.	.
• Holes in the floor for volleyball poles	.	.
• Holes in the floor for badminton poles	.	.
• Lines for floor hockey	.	.
• Lines for soft lacrosse	.	.
• Lines for basketball	.	.
• Lines for badminton	.	.
• Lines for volleyball	.	.
• Wall dividers to split the gym into two parts	.	.
• Bleachers to encourage spectator sports	.	.
• Rock wall and all safety equipment*	.	.

	Score
Gold Standard	10
No access to a gym	0
Any room called a *gym* or *gymnasium*	1
For each of the above that is in the gym	+1 (to max score of 9)

* not having a rock wall cannot prevent a gold standard score but having a rock wall can add 1 to the score

EQUIPMENT

The "Gold Standard" is a school that contains all of the following equipment, in good working order and in large enough quantities to allow for thirty students to participate at one time.

Approx. No.

Ball, Floor, &/or Cosom Hockey
- Plastic Sticks ___
- Soft Pucks/balls ___
- Nets ___
- Protection (goalie masks, pads) ___

Lacrosse (soft)
- Molded Plastic Sticks ___
- Nets ___
- "Soft" Lacrosse Balls ___
- Protection ___
  – face mask for goaltender

Badminton
- Racquets ___
- Shuttles ___
- Nets/Poles ___

Volleyball
- Balls ___
- Nets ___

Basketball
- Nets ___
- Balls ___

Track/Field
- Discuses ___
- Javelins ___
- Shot Puts ___
- Hurdles ___
- Pole Vault Poles ___

Touch/Flag Football
- Balls ___
- Flags ___

Tennis
- Balls ___
- Racquets ___

Approx. No.

Aerobics/Dance/Rhythmic Gymnastics
- Stereo System ___
- Steps ___
- Bikes ___
- Mats ___

Weightlifting
- Free weights ___
- Benches ___
- Universal machines ___
- Other machines ___

Softball
- Softballs ___
- Bats ___
- Gloves ___
- Protection (catcher's mask/chest protector) ___

Wrestling
- Wrestling mats or general utility mats ___
- No gaps between mats. ___

Soccer
- Indoor Balls (nerf) ___
- Goalie Gloves ___

Gymnastics
- Crash Mats ___
- Pommel Horse ___
- Rings ___
- High bar ___
- Balance Beam ___
- Mini-tramp/Beat Board ___
- Parallel/Uneven bars ___
- Floor/mats ___

For each of these sport/activity categories rate a score out of ten. A 10 is reserved for a school that has every piece of equipment in that category in perfect working order. A score of zero is reserved for a school that does not have any of the equipment in that category. A *one* is the lowest score possible for a school that has at least some of the equipment in any given category. A bonus point is given if the school has any equipment that is not listed above. Another bonus point can be added to the final score if there is enough equipment for a double class to participate at the same time.

Score	# Students
9	25 - 29
8	22 - 24
7	19 - 21
6	16 - 18
5	13 - 15
8	10 – 12
3	7 - 9
2	4 - 6
1	1 - 3

Once a score out of 10 has been determined for each sport/activity category the score will be reduced to an overall score by dividing the sum of category score by the number of categories.

POOL

The "Gold Standard" is a school that contains all of the following aquatic facilities and equipment.

	YES	NO
• Indoor Pool at least 25 metres or 25 yards in length and 6 lanes wide	.	.
• Lane ropes for each lane	.	.
• A shallow end no deeper than 4 ft. and a deep end no shallower than 9 ft.	.	.
• Starting blocks for each lane	.	.
• Diving board	.	.
• Slide(s), rope(s), recreational equipment	.	.
• Separate diving pool and diving tower	.	.
• Waterpolo nets (2)	.	.
• Flutter boards	.	.
• Pull bouys	.	.

A "Gold Standard" pool will receive a 10 score on the continuum scale of zero to ten. A zero score is reserved for a school without access to a pool. One point will be given for each of the above that is observed present to a maximum score of 10. For flutter boards and pull bouys at least 20 must be present in order to achieve a full point. For each board or bouy missing 0.05 of a point will be deducted. For a pool that is less than 25 metres or 25 yards in length and/or less than 6 lanes wide a score of 1 is assigned if none of the other "Gold Standard" criteria are met.

FIELDS

The "Gold Standard" is a school that has all of the following fields.

	Approx. No.	YES	NO
• Practice fields (1 point for each practice field available up to 3 points)	_____	.	.
• Playing fields (1 stadium with bleachers)	_____	.	.
• Football standards		.	
• Soccer goals		.	.
• Baseball diamonds with backstops		.	.
• Field Hockey		.	.
• Track (400 m)		.	.
• Field events space (discuss, long/triple jump, pole vault, high jump, etc…)		.	
• Tennis Court		.	.
• Outdoor lighting		.	.

A "Gold Standard" school will receive a 10 score for having each of the above. A score of zero is reserved for a school that has no field space available to the students. A point is given for each item that is accessible. If there are no practice fields the field does not have to be a stadium with bleachers.

ARENAS

The "Gold Standard" is a school that has all of the following arena spaces.

	YES	NO
• Skating arena (hockey, ringette & figure skating)	.	.
• Curling	.	.
• Rollerblading, Rollerskating & Skateboarding	.	.
• Ramps and/or half-pipes	.	.
• Indoor track	.	.

A "Gold Standard" school will receive a score of 5, one point for each of the above. A school that has none of the above items will receive a score of zero, and a single point will be given for each of the above that exist. The final score out of 5 will be doubled to create a score out of 10.

CHANGE ROOMS AND SHOWERS

	1	2	3	4	5
• No odour	.	.	.	.	.
• Clean locker rooms (no of clothes and garbage lying around)	.	.	.	.	.
• Clean shower spaces	.	.	.	.	.
• Enough bench space to have a class of 30 sit while changing	.	.	.	.	.
• Enough storage space for a class of 30	.	.	.	.	.

	YES	NO
• Individualized storage space for each sport team in the school	.	.
• Separate locker rooms for different sport teams	.	.
• Hair dryers	.	.
• Towels provided	.	.
• Single stall showers	.	.
• Male and female changerooms	.	.

A score of out of 5 will be given for each of the following items. They will be rated as described in the chart below.

Score	Odour	Clean Lockers	Clean Showers	Bench Space	Storage Space
1 (-3)*	Awful smell	Garbage, wet towels, clothes, junk (books, paper, etc…)	Garbage, wet towels, clothes, junk (books, paper, etc…)	Enough for 1 – 5 students	Enough for 1 – 5 students
2 (-1.5)*	Bad or musty smell	Wet towels, clothes, junk (books, paper, etc…)	Wet towels, clothes, junk (books, paper, etc…)	Enough for 6 – 10 students	Enough for 6 – 10 students
3 (0)*	Body odour smell	Clothes, junk (books, paper, etc…)	Clothes, junk (books, paper, etc…)	Enough for 11 –15 students	Enough for 11 –15 students
4 (1.5)*	No smell	Junk (books, paper, etc…)	Junk (books, paper, etc…)	Enough for 16 – 20 students	Enough for 16 – 20 students
5 (3)*	Clean smell	Clean area	Clean area	Enough for 21 – 30 students	Enough for 21 – 30 students

*The scores in brackets are for the odour, clean lockers, and clean showers categories. These scores range from –3 to 3 (out of 3) because dirtiness and smells might actually deter students from participating in physical activity.

For the remaining items a single point will be awarded if the item exists or else a score of zero will be placed for that item. All of the points will be added up providing a total sum out of 25. The score will then be multiplied by 0.4 in order to create a final score out of 10. A final score of 10 is reserved for a "Gold Standard" school and any school that has any type of locker room cannot receive a score less than 1.

ACCESSIBILITY/SECURITY

	YES	NO
• Separate entrance to athletic facilities to support access outside of school hours	.	.
• Access ramps for wheel chair bound people	.	.
• Bright enough lighting to ensure security	.	.
• Protected windows to prevent break and entries	.	.
• Secure storage areas to reduce vandalism	.	.

A "Gold Standard" school will receive a score of 5, one point for each of the above. A school that has none of the above items will receive a score of zero, and a

single point will be given for each of the above that exist. The final score out of 5 will be doubled to create a score out of 10.

A final total score out of 70 will be calculated by adding up all of the scores. This will provide an overall environmental score.

The following items were used from the Student Physical Activity and Smoking Survey (Health Behaviour Research Group, 1999). Only the items from the questionnaire that were used in the data analysis are presented. These items are numbered as they appeared in the actual questionnaire booklet.

1) What grade are you in?
- ☐ Grade 9
- ☐ Grade 10
- ☐ Grade 11
- ☐ Grade 12
- ☐ Grade 13/OAC

3) Are you male or female?
- ☐ Male
- ☐ Female

14) Over the past week, how many days did you participate in <u>hard</u> physical activity? *(exercise such as jogging, jazz dancing, basketball, and mountain biking, which increase your heart rate and make you breathe hard and sweat).*

☐ 0 days	☐ 2 days	☐ 4 days	☐ 6 days
☐ 1 days	☐ 3 days	☐ 5 days	☐ 7 days

15) On average how many minutes of <u>hard</u> activity did you do on each of those days?

☐ 0-9 min.	☐ 30-39 min.
☐ 10-19 min.	☐ 40-49 min.
☐ 20-29 min.	☐ 50+ min.

17) Over the past week, how many days did you participate in moderate physical activity? (*lower intensity activities such as walking or bicycling to school and recreational swimming).*

☐ 0 days	☐ 2 days	☐ 4 days	☐ 6 days
☐ 1 days	☐ 3 days	☐ 5 days	☐ 7 days

18) On average how many minutes of moderate activity did you do on each of those days?

☐ 0-9 min.	☐ 30-39 min.
☐ 10-19 min.	☐ 40-49 min.
☐ 20-29 min.	☐ 50+ min.

23) How many of your closest friends participate in physical activity?

☐ None of them	☐ Most of them
☐ A few of them	☐ All of them

24) Not counting yourself, how many people in your home participate in physical activity?

☐ 1	☐ 3
☐ 2	☐ 4

41) How sure are you that you can do the following things on your own time outside of school?

	I'm sure I can't	Unsure	I'm sure I can
Get up early, even on weekends, to exercise	☐	☐	☐
Exercise even though you are feeling sad or highly stressed	☐	☐	☐
Stick to regular exercise even when your family or friends demand time from you	☐	☐	☐
Stick to regular exercise even when you have a lot of school work to do	☐	☐	☐
Set aside time for regular exercise	☐	☐	☐

APPENDIX IV – CONSENT FORMS & REQUEST LETTERS

Consent Form (Survey)

Physical Activity As A Smoking Cessation Strategy For Teenagers

Research Investigator:
Ron Plotnikoff, Assistant Professor
Faculty of Physical Education and Recreation
& Centre for Health Promotion Studies
University Ext. Building
University of Alberta, Edmonton, AB
Phone: (780) 492-4372 Fax: (780) 492-9579
E-mail: ron.plotnikoff@ualberta.ca

You are asked to give parental or guardian consent to have your daughter/son to participate in a survey which (1) examines gender differences in smoking and physical activity and (2) explores the potential role of physical activity as a prevention strategy for tobacco use. Results of the study will: (1) assist in the development of youth smoking prevention and cessation programs and tobacco control prevention policies; and (2) help schools develop physical activity strategies that will assist students to either quit smoking or prevent them from starting.

The students will be asked to provide information on their (1) physical activity behaviour and (2) smoking experiences and attitudes.

If you agree to have your son/daughter participate in the study please read the following and sign your name at the bottom of the page: ***(note: the consent form will be modified for students 18 years and older)***

I understand that participation in this study is voluntary.

I understand that all information gathered is confidential. To ensure confidentiality, raw data will be coded and stored in a locked office to which only the investigators have access. Normally data is retained for a period of five years after publication, after which it will be destroyed.

I understand that the student can withdraw from this study at any time without penalty or consequence. If the student declines to continue or withdraw from the study these data will be removed from the study upon my request.

I understand that there is no remuneration for participating in this study.

I understand that the survey will be approximately 30 minutes on one occasion.

I understand that the information in this study will be used in a final report prepared by the researchers. As well, the information may be presented at professional conferences, published in academic and non-academic publications, and educational purposes. All information regarding my identity will be removed and code names where necessary will be used to protect my privacy.

I understand that given the instrumentation used to collect the data in this study (i.e., questionnaires), the risks associated with participation revolve around the disclosure of confidential information. This may make some participants uncomfortable.

I have received an explanation and understand the nature of the study, its purpose and procedures. I understand that I may ask questions at any time during the study and have them answered to my satisfaction.

I will receive a copy of the signed consent form.

The University of Alberta creates and collects information for the purpose of research and other activities directly related to its educational and research programs. All participants in research projects are advised that the information they provide, and any other information gathered for research projects, will be protected and used in compliance with Alberta's Freedom of Information and Protection of Privacy Act.

If you have read and understood all of the above, please sign your name on the bottom and check **ONE** of the following boxes:

☐ Yes, I agree to have my son/daughter participate in the study. ☐ No, I do not agree to have my son/daughter participate in this study.

(Participant name, printed)

Parent/Guardian name, printed)

Parent/Guardian signature

Signature of Researcher Investigator Date

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Monday, October 25, 1999

Dear Parent Guardian,

This letter is about a school research study on youth, tobacco, and physical activity *called "Physical Activity as a Smoking Cessation Strategy for Teenagers"*. This study which involves Frank Maddock High School is funded by the National Cancer Institute of Canada and is being conducted by Dr. Ron Plotnikoff. Dr. Plotnikoff is a faculty member at the University of Alberta who is interested in promoting ways to help people live healthier lives.

The purpose of the study is to: 1) examine gender differences in smoking and physical activity; and 2) explore the potential role of physical activity as a prevention strategy for tobacco use. Research in this area is timely given the National Cancer Institute of Canada's (NCIC) identification of lung cancer as the leading preventable cause of cancer death for both Canadian men and women in 1998.

In November 1999, we will conduct a brief survey on smoking and physical activity with all students in grades 10 through 12. In addition, we will conduct four focus (discussion) groups with a small volunteer sample of girls from grades 10 through12.

The research findings will assist in the development of youth smoking prevention and cessation programs and tobacco control prevention policies. It is expected that the results will help high schools develop physical activity strategies that will assist students to either quit smoking or prevent them from starting.

The survey is anonymous for those who agree to participate in the study. In other words, we do not require the student's name to be written on the survey. Individual responses will be kept completely confidential and no individual results will be made available to school or other personnel. To ensure confidentiality, raw data will be coded and stored in a locked file cabinet. Codes rather than participant names will be used when entering survey data into computer files for analysis. All data will be published in group form so that it will be impossible to determine the responses from any individual student.

The focus group responses will be kept private and confidential. In order to help with the data analysis, all interview and focus group data will be tape recorded and then typed up. Tape recordings will be erased subsequently and all typed transcriptions will be stored in a locked filing cabinet. Similar to the survey data, codes rather than student names will be listed on each transcript. Responses will be published in group form and no individual results will be made available to school or other personnel.

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The survey will take approximately 30 minutes to complete. Teachers will administer the surveys during a homeroom or other settings designated by the school. The study's research assistant will be available to assist with questions regarding the survey. The focus groups will take approximately 45 minutes to complete. In cases where the survey will be administered during school time, those students not participating will receive normal school class instruction from a teacher or supervised library/study time.

We have received permission from the school board and the principal to conduct this research. The research has been reviewed and ethics approval has been granted by the University of Alberta. There are no foreseeable risks involved with this study. However, the final decision to participate must be made by the individual parent and student.

Your co-operation in permitting your son/daughter to take part in this research is greatly appreciated. However, there is no penalty of any kind if he/she does not participate. Your son/daughter or yourself may withdraw participation at any point without consequence. Your son/daughter need only tell the teacher who is administering the survey that he she wishes to withdraw from this study, or inform the researcher at (780) 492-4372. The decision to participate or not will not affect your son/daughter's relationship with either Frank Maddock High School or the University of Alberta. A student will not be included in the study if a parent or guardian declines his/her participation or if the student does not agree to take part.

If you have any questions concerning the study, do not hesitate to call the Study Co-ordinator at (780) 492-4372.

Sincerely,

R Plotnikoff

Ron Plotnikoff, Ph.D.
Assistant Professor
Faculty of Physical Education and Recreation &
Centre for Health Promotion Studies-
University of Alberta

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October 7, 1999

Dear Principal,

I represent a team of researchers at the University of Alberta and Waterloo University who are interested in obtaining data to examine the association between smoking and physical activity with high school aged youth. We have received Federal funding (National Cancer Institute of Canada) to conduct a research project on Alberta and Ontario high school students. The Superintendent of your School Region has also been notified about this project. As part of our methodologic design, our objective is to sample four non-urban schools in Alberta and four urban schools in Ontario. Your school qualifies to be selected as part of the Alberta sample. We will randomly select four schools from the pool of schools that grant permission to complete the research.

In brief, we are interested in examining: factors influencing smoking and physical activity based on gender; perceived benefits and barriers to physical activity; and, the extent to which physical activity can be used as a strategy for smoking cessation among teenage girls. If your school is used in our study, you will be sent a package of information including: a synopsis of the project; informed consent forms; and a copy of the questionnaire.

The study will consist of two phases. The first phase is a survey, which will be conducted with all the male and female high school students from grades 9 – 12, from four non-urban high schools. A questionnaire will be administered in the fall of 1999 and will take approximately 30 minutes to complete. The questionnaires will be administered in homeroom or other settings, as you designate, and a teacher will be requested to be present at each of the data collecting sessions. Additionally, in order to contextualise our findings, the questionnaire administrator from our research team will conduct some unobtrusive observations of the physical environment (i.e., an examination of the facilities and equipment) on the same day the questionnaires are being completed.

The second phase consists of focus groups with females from your school, and will be conducted early in the year 2000. The four focus groups (7 – 10 students per group), conducted by a trained teacher on our research team, will collect in-depth female-centred information on physical activity and tobacco use. These focus groups will take approximately 45 minutes to complete and will be held during homeroom or other settings or times, again as you designate. Volunteers will be recruited for the focus groups. Recruitment will involve a morning PA announcement, homeroom teacher announcements, posters and word-of-mouth. Participants in the focus groups will not receive compensation, however, snacks and soft drinks will be provided during the focus group sessions. Information letters and consent forms will be sent home for parents for both phases.

In the first phase of the study, the teachers and respondents will not have access to the student questionnaires and in the second phase, anonymity of the responses will be assured to all of the participants. The students may decline to participate in the study and can withdraw anytime without any consequences. This study has the approval of the Ethics Review Committee of the Faculty of Physical Education and Recreation at the University of Alberta. Results from this study will be

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reported in an aggregated form and will be used for educational purposes only (e.g., journal articles, oral presentations, conference proceedings, future research proposals). A summary of the results will be sent to you once they are available.

We request your permission to use your school for this study. In order to indicate your interest we have included a FAX-BACK form with this letter. Please either check YES or NO for your school to indicate whether a research coordinator can contact you and send the rest of the information. Please fax the FAX-BACK form as soon as possible as we would like to commence our research in the latter part of October.

Thank you in advance for your time and consideration for this very important project. Your contribution is both highly valued and necessary to examine the issues surrounding physical activity and smoking in high school aged youth. If you have any questions please do not hesitate to call me at (780) 492-4372.

Sincerely,

R Plotnikoff

Ron Plotnikoff
B.A. (Ed.), M.Ed. (Student), M.Ed., Ph.D. (Medicine)
Assistant Professor